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EDITORIAL NOTES.

The North British Presidential Address.

IT was a matter of the deepest regret to Mr. David Vass, the President of the North British Association of Gas Managers, that the members were not the guests of the Perth Town Council, but were meeting in Glasgow, on the occasion of their annual meeting on Thursday. The change from pre-arranged Perth to convenient Glasgow was, just the same as the removal of the French Government from Paris to Bordeaux, a precautionary measure. It is just possible that, had there been no change in view of the disturbed conditions and uncertainty of railway communication, the muster of members at Perth would not have been of the same dimensions as it was at Glasgow. But the visit to Perth, and the welcome and hospitality that the members are bound to receive at the hands of the Town Council, are only pleasures deferred. However, the proceedings at the meeting were interesting from every point of view—more than usually so; and every subject brought before the members was apposite to the changing times through which we are passing on the technical side of the gas industry. There is in these days so much to be considered, studied, investigated, and adjudicated upon, and, if of value, pursued and developed, that there is little time that can be profitably spared for looking backward. The only justification for retrospect is found in the enhanced ability conferred by comparison of viewing in the correct proportions the marvellous economic progress that has been achieved by the industry. The economy of progress has spread itself in every direction, and has had vast influence in consolidating and strengthening the industry on its every side. Had it not been so, the industry would have long since gone under from the assaults of its competitors.

The economic progress is mirrored by the history of Perth gas supply as related in the forepart of the Presidential Address. With improvements in plant, there has been a great cheapening of production; this cheapening has helped through lower prices to the consumers to extend business; and the enlarged demand has given still greater scope for the further lowering of the cost of production—production not only of gas, but of residual products. When it is seen that in the last twelve years the costs of gas manufacture have dropped by 2·484d. per 1000 cubic feet (despite the higher charges in various directions), and that the revenue from residuals has increased by 6·505d. per 1000 cubic feet —making together a difference of 8·989d., and reducing the net cost of gas into the holder to 1s. 0·33d., there is the all-sufficient evidence of good work having been accomplished which has yielded advantage to the consumer. Mr. Vass has found the weak spots in the Perth undertaking; and one of them has been the heavy capital account, which ever since the concern was bought forty four years ago has been a drag on it. The weight of the capital appears to be, though diminished in relation to output, a never-ending trouble; but the best means possible have been taken, through development and economy, to lighten the burden. One of the best means of attacking the knotty problem of the reduction of capital in relation to business done is not only through the sinking fund and depreciation account, but through the existing consumers. All the additional business that can be obtained from them is secured at a proportionately lower expenditure than is business from new consumers, though, in the interests of both present and future expansion, the latter must be assiduously cultivated. They are the "existing" consumers of to-morrow. Just forty-four years ago, interest and sinking fund amounted at Perth to no less than 26d. per 1000 cubic feet of gas sold. Then it was gradually brought down—that was, in 1901-2—to 10d. There has since been an increase of 1·38d., which may be only temporary. For this increase, however, in the capital charges, no doubt the improvement in the works' plant has been largely responsible; but the increase is covered several times by the descent, by about 9d., of the net cost of gas into the holder.

The President has his grumble over the system of arriving at the assessable value of gas undertakings, which, he says, works out unfairly "in that it practically depends on the "amount which must necessarily be raised to meet interest "and sinking fund—the greater the amount required for "such funds, the greater the assessable value; whereas it "will be easily seen that the capital value has only a remote "relation to the business done on the area of ground covered "by the undertaking." Of course, Mr. Vass is referring to Scotland, which is in a peculiar position in relation to the means available for assessing its municipally owned gas-works, seeing that under the Burghs Gas Supply (Scotland) Act, local authorities are prohibited from making a profit, other than what is necessary for annuities, interest, sinking fund, and depreciation. In England, there is also dissatisfaction over the principles applied to the rating of gas and cognate undertakings. But it is far from likely that a system will ever be devised which will meet with universal approval. The Scotch method, however, is incontrovertibly unfair. Messrs. Thomas and William Newbigging, in their book on the "Principles and Practice of Valuation for Works "Assessment," remarking on the Scotch procedure, say that, although it is less complicated than the English, "we ques-"tion whether, as applied to gas and kindred undertakings, "it is as fair." Mr. Arthur Valon, in his "Rating of Gas and "Water Undertakings," also refers to the position of local authority undertakings not conducted for pecuniary profit. He observes that in such cases "a rent might be expected "approximately equal to the annual cost occasioned by the "capital expenditure which has been incurred. The rate-"able value is therefore, in such cases, estimated by taking "a percentage upon the capital outlay. If the cost to the "actual body is taken, and the percentage on the capital "limited by the rate at which the actual owner can raise "money, it is not sufficient to apply this to the structural "value of the undertaking, but to the total capital expendi-"ture which it might reasonably be expected it would be "necessary to incur as an alternative to a tenancy." Mr. Valon does not comment upon the fairness or otherwise of this procedure, except that he points out that due allowance must be made for any expenditure which has been incurred in order to obtain the advantages of ownership. What is the remedy for the obviously inadequate basis of assessment —"inadequate" because disuniform and unfair—of which Mr. Vass complains? He suggests as a basis the "struc-"tural value of the works, or some such means, as would "make the assessable value of any two gas-works of similar "ground area and annual output, considering geographical "situation, approximately equal." Structural value is just as unsafe as capital as a basis; for there are so many considerations which appreciate or depreciate structural value. The maintenance of structural value at a high level would, if it were made the main basis for assessment, be an absolute disadvantage in that connection.

In plant and practices, the Perth Gas-Works are manifestly up-to-date. While we will not traverse point by point the information in the address in regard to them, we may recommend for perusal the various tables of costs which the President has presented. They will be found extremely useful. In the first place, there are comparative costs with West's manual stoker and De Brouwer machinery. The latter shows valuable economy, and probably higher efficiency is also expressed in terms of make per ton. But taking the bare costs, the West manual stoker did not in its day do at all badly. Then not many gas-works the size of Perth has a tar-distilling plant. Here, again, the working expenses are shown; but there is no balance-sheet or other particulars as to the quantities of naphtha, light oil, creosote, and pitch resulting from the distillation. The working expenses, 0·364d. per gallon of tar treated, are low —much lower than is found in some works—assuming that distillation covers the work indicated by the commodities just mentioned. All the costs of operating the ammonia

plant are also given; and there, again, in comparison with some other works, 6os. 8·92d. per ton of sulphate is evidence of economical operation for the size of plant. We are pleased to see that this total cost includes a subscription to the Sulphate of Ammonia Association—Mr. Vass being very much alive to the necessity of some organized effort in seeking to cause the demand for sulphate of ammonia to increase at a rate which will absorb the increase in make, and in working for the general benefit of the whole market. It is to be hoped that his suggestion as to concerted investigation for the purpose of arriving at the average quantity of ammonia present in crude gas at different periods of carbonization will not go unheeded. Following on, there are further useful tabulated costs as to cleaning, repairing, and renovating cookers and hot-plates, as well as the working costs of a tinning plant which he has put down. These data do not invite comment, other than the one that they all prove economy and propriety and may furnish guidance to others.

The final subject dealt with in the address was that of gas-fitting apprentices. We can hardly understand the objection that the fitters of the Gas Department have taken to the proper instruction of apprentices, and so seriously to heart that the Gas Workers' Union intervened. If the objection is on the ground that they are afraid the student will become the superior of the teacher and displace him, this does not say much for the value of the teacher's own experience and ability. There is plenty of room in the gas industry for qualified fitters; and it is only those who do not interest themselves in becoming fully qualified for whom there is no room. The difficulty of getting wholly competent men is great; and gas-works must necessarily take into their own hands the matter of raising competent men. When trade unions begin to interfere with the steps taken to provide skilled men—whose skill, producing satisfaction, will make more employment—then one of the chief tenets of trade unions is assailed from within, and the value of the organizations to the workers of the country is seriously affected. One of the objects of trade unions is surely to help in the creation of work through fostering efficiency. Opposing the raising of the efficiency of men is not conducive either to the object named or to the men showing through their work the higher value which commands an improved wage. However, the information on the subject of the industry's requirements and the way to meet them which Mr. Vass collected and has incorporated in the address appears to have satisfied the Gas Workers' Union as to the futility of any remonstrance over a matter that is both reasonable and necessary. We can only say "appears to have satisfied," inasmuch as the Union officials have simply been silent on the subject since they received the information which could not have been formerly in their possession.

Catalysis the Hope of the Gas Industry.

An extensive reader and gifted theorist and investigator such as Dr. Rudolf Lessing is capable of dressing-up in attractive garb practically any physical or chemical subject. His ability in this respect did not fail him in preparing the William Young Memorial Lecture for the North British Association meeting. The points constituting the fundamental parts of the subject, and the historical references, we have, in different phraseology, met with before; but what interests most in the lecture is the clever way in which Dr. Lessing has managed to interweave catalysis into most of the processes of gas manufacture from the carbonization of coal through to the finished primary product, and to the enhancement of the secondary ones. We rise from a perusal of the lecture, as the members of the Association must have risen from the hearing of it, with the feeling that catalysis in our manufacturing processes is a ubiquitous sort of thing, undreamt of in times past; that when one cannot give a *raison d'être* for any reaction or chemical change that one comes across, then it will be fairly safe, on Dr. Lessing's authority, to attribute it to catalytic action; and that further study of the activating power of catalytic agents upon the production of valuable reactions and chemical changes will be of vast importance to the gas industry in cheapening and promoting the efficiency of its processes. We are pleased with the lecture, because of its broad suggestiveness; but at the same time we must compliment the lecturer upon the liveliness of imagination which has enabled him to trace backwards, in such a variety of places in gas practices, effect to cause, and the cause so invariably a catalytic one. There is no support, in the majority of instances, either to the acceptance or the rejection of what Dr. Lessing puts forward, because the theory has not yet been subjected to the proof of exact and searching experiment. The lecturer himself has not put to trial many of the points he makes; and although he is engaged in an investigation into the influence of mineral matter upon carbonization (and is so far satisfied that the influence exerted by various substances on the resultant products differs considerably according to the chemical nature of the substances), he has not yet advanced sufficiently to feel safe in publishing any results. We notice, too, the use of qualifying or covering words in the lecture—such as "probable," "possibility," and "in my "opinion." For these various reasons, most interesting and suggestive—cleverly suggestive, we may say—as the lecture all is, there is much about it that comes under the heading of hypothesis; and it is a prudent thing to accept hypothesis with a little reserve until it has been placed in the category of established fact.

It is upon the suggestive side of the lecture that the greatest advantage is to be found, as it opens to view a vast area within which investigators into physical and chemical problems might engage their probing faculties. Catalytic action may be good, or it may be bad. The work of the investigator is to discriminate between the good and the bad; and to try to find ways and means of assisting the former and eliminating or reducing the latter to a minimum. The mineral substances in coal, says the lecturer, probably act as catalysts. It would be a good thing if they did not always do so. During the passage of the gas through the heated material and space in retorts, beneficent work is done in the conversion of the hydrocarbon vapours into the simpler gaseous constituents of gas; but the destructive work in reducing the value of certain of the constituents and in promoting impurity, under high temperature carbonization, is not at all in keeping with an ideal efficiency. Hence contact and exposure have been diminished as far as possible by the use of heavier charges and longer carbonizing periods. The walls of the retorts themselves are in the nature of catalysts; and certain actions that have very disagreeable consequences are accelerated by the vapours resulting from the carbonization of the coal coming into contact with them. Reactions are set up which cause the deposit of carbon on the walls of retorts; and this carbon in turn forms a catalyst. This is where Dr. Lessing makes his first suggestion for study. The physical structure and the chemical composition of the material from which retorts are made must influence decomposition, and the direction in which it proceeds. Then, again, smooth or porous surfaces must have effect; and glazed retorts may show different behaviour from unglazed ones. Regarding the differences in catalytic effect of variations in the constitution of retort materials, we do not know anything; but it might be of substantial advantage if we did. We say "might" because, under modern systems of carbonization, the old troubles are not so pronounced; and so catalytic influences so far as the retort material is concerned have been further reduced in importance in relation to the superior factors of refractoriness and the other physical conditions which make for durability, and of conductivity and so forth which make for efficiency. The gift of adaptation of subject to occasion was shown in this connection when the lecturer said: "The "importance of the catalytic or contact action of the retort "material was clearly recognized by William Young, "though not expressed in so many words. By his radiant "heat theory, he obviously aimed at the fixation of hydro-"carbon vapours by heat in such a way that the rapidity of "complete destruction was not intensified and accelerated "by the catalytic influence of the retort walls."

On the point as to the part catalytically played by the ash or mineral matter of coal in directing its decomposition, Dr. Lessing fell back for illustration upon the revival of coal-liming by Mr. R. O. Paterson. There has been something a bit mysterious about certain of the improvements in working that succeeded the introduction of systematic coal-liming at Cheltenham; and Mr. Paterson and those who have worked with him in this matter could not advance any enlightening information, nor would they offer any hypothesis. Sufficient for them were the results that succeeded the introduction of, and were maintained by, coal-liming. Now Dr. Lessing boldly confronts us with an explanation as to why it is the lime-surfacing of the coal has the effect of preventing stopped pipes and scurfing troubles. He asserts that the freedom from these troubles is "proof" of the far-

reaching influence of lime as a catalyst. He is insistent upon this being the solution, because he adds: "There can-" not be the slightest doubt that the lime acts in this case " catalytically; accelerating the primary formation of perma-" nent gas and of such tar vapours as are not liable to excess-" sive decomposition down to solid carbon." This is the only explanation having the appearance of being rational that has so far been advanced; but whether the results can be regarded as "proof," and as justifying the positiveness that underlies the words "there cannot be the slightest doubt," is another matter. It seems to us that something more is required than assumption and allegation, even by Dr. Lessing, before there is an absolute acceptance of the proffered solution. But on the more important point Dr. Lessing does not advance any information supplementing the theories he hastily formed at the time of the Southern Association meeting in 1911, as to the part that the lime-jacketing of the coal actually plays in reducing (compared with prior experience) to about one-half the sulphur content of the finished Cheltenham gas. As Mr. Charles Carpenter, D.Sc., pointed out at the Institution meeting last June, the reduced figure is about that found, in the absence of coal-liming, with intermittent carbonization in vertical retorts at Sunderland. However, if the lecturer attributes the reduction of the sulphur content of the Cheltenham gas to the lime acting as a catalytic agent, then the coal-liming process, good as it is in effecting its purpose up to a point, suffers badly in comparison with the application to purification of another catalytic agent on the grand scale as practised at the works of the South Metropolitan Gas Company.

There is much else in the lecture which leaves us wandering about among the processes of gas-works operation, and suggests at almost every turn a place where catalysis may be usefully employed. In the domain of carburetted water-gas manufacture, catalysis can be utilized in the direction of transforming the mixture of hydrogen and carbon monoxide into methane; and here Dr. Lessing holds out hope of a "perfect solution" for the disposal of surplus coke. If this comes about, he will deserve well at the hands of the gas industry. If the new methods for the production of cheap hydrogen (which are largely based on catalytic reactions) can be perfected, then it may be hoped that, by a judicious combination of water gas and hydrogen plant, the catalytic conversion of the mixture into methane would supply non-poisonous gas of high calorific value. The use of the word "if" at the beginning of this passage from the lecture tends to rather damp the hope of any immediate realization. Incidentally, the reference to carbon monoxide reminds of the suggestion of Professor Sabatier (whose researches into catalysis form a classical contribution to the subject) that, by the passing of carbon monoxide over nickel at a temperature of 250° C., carbon dioxide and carbon are obtained. If this be so, it would form a practical method of freeing gas, if desired, from the carbon monoxide it contains. But neither in Mr. Carpenter's paper before the Société Technique last year, nor in his lecture at the Institution meeting this year, does the analysis of South Metropolitan gas, before and after treatment, using nickel as the catalyzer, show any material reduction of the carbon monoxide.

Coming to the influence of catalysis in the realm of the secondary products of the gas industry, the most interesting point is the one describing the application of the principle to the production of synthetic ammonia. The process comprises the direct combination of hydrogen and nitrogen in the presence of catalysis, under high pressure and at high temperature—the hydrogen itself being made from water gas by a catalytic method. The high pressure and high temperature are referred to by the lecturer as difficulties opposed to carrying on the process on a large scale; and he alludes to a plant being in existence having an annual capacity of 3000 tons of ammonia. The "difficulties" do not appear to cause any hesitation on the part of the Badische Company, if Sir William Crookes is rightly informed; for he was recently saying that this Company, by the end of 1915, would have a plant in operation equal to the annual production of 130,000 tons of ammonia. This was stated before peace was interrupted.

The lecture cannot fail to arouse interest; and if Dr. Lessing has entered up to the credit of catalysis more than further study and research certify, he may be excused if, by so doing, his lecture incites to investigation, for he has said enough to show here that catalysis in directions unthought of does serve the practical ends of life, and will do so still more in the future, as we arrive at its better understanding.

Splitting Hairs, and Some Practical Work.

We have all admiration for the thorough work that Mr. Walter Grafton has done; and he deserves, though it is feared that he does not think he has received, the fullest credit for it. But on the ground of policy, and for personal reasons, there are parts of the paper that he read last week before the North British Association of Gas Managers that, in our opinion, might well have been omitted, without any loss to the author, or to the value of his contribution. At this time of day, there is no particular interest in entering into any discussion as to whether or not Mr. Charles Carpenter, D.Sc., and Mr. Grafton were partners in the development of the "Metropolitan" No. 2 burner, or whether they had both been working independently, and it happened that Mr. Carpenter "got there first," though not so far as the stage at which Mr. Grafton subsequently arrived, by which not only two but the three air supplies to his burner are brought under regulation. By this third regulation, the author claims, and the tests presented show that he has reason for the claim, that his development meets with the principle laid down by Parliament, that the burner used for testing the illuminating power of gas should be the one that (to put it shortly) will develop from the gas the greatest amount of light. That is only fair. But the refinements made in test-burners which improve their efficiency remove them farther than ever from the form of burners that are most available to the consumers of gas. For this reason, apart from the dominancy of incandescent gas lighting, there is no practical value in such a form of testing. Later on in his paper, Mr. Grafton himself, in dealing with calorimetric tests, confesses as much when, in advocating non-luminous flames in the calorimeter, in order to secure the maximum gross thermal value of town's gas, he says: "Besides, this is the way *most* of the gas is used to-day, "whether for incandescent lighting, cooking, fires, or "engines;" and, further, "flat-flame burners are not in "accordance with modern usage and methods of burning "gas, except for lighting, and their safe use in geysers." That "except for lighting" appears to have been a second thought, as we cannot conceive of Mr. Grafton holding that lighting by flat-flame burners is a proper "modern usage" of gas.

However, there is no use to-day spending much time—in fact, it is a sheer waste of time—kicking against the sensible decree that any commodity should be tested for the quality that is of supreme importance to the consumers, and not for a quality that is of secondary value, as Mr. Grafton himself shows (although it is not in consonance with his argument) illuminating power to be. Yet he holds that "it "makes practically no difference in working by the illumi-" nating test—provided you get the maximum value, it is "as good as the thermal one, and serves every purpose of "protecting the public as to its [*sic*] heating value. Illumi-" nating value safeguards calorific value." That all depends upon the gas supplied. Look at the tables in Mr. Grafton's own paper. The figures show one test for carburetted water gas (using his burner) of 17·05-candle power, and a calorific value of only 477 B.Th.U. gross; a mixed gas of 15·81-candle power, but showing a calorific value of 540 B.Th.U. gross; and further a coal gas of 16·51-candle power, but of a calorific value of 580 B.Th.U. gross. Let us remind him that gas is "most used" for certain purposes by the consumer. Is a consumer protected by a test that will show an illuminating power result of 17·05 candles for a gas of 477 B.Th.U. gross, 15·81 candles for a gas of 540 B.Th.U. gross, and 16·51 candles for a gas of 580 B.Th.U. gross? The consumer has no protection under the illuminating power test against the supply to him of gas complying with that test, but variable in composition, in density, and in calorific value. The author's own paper proves conclusively the fallacy of his contention in favour of the retention of the test. Only a few days ago—since Mr. Grafton's paper was put in type—a gas man was discussing with us the question of the retention of the illuminating power standard and test, and took his stand on the very ground that the test gave him latitude in the use of heavier percentages of carburetted water gas than is the usual practice, and masked the variations in calorific value. We are, as our readers are well aware, anything but opposed to the use of carburetted water gas; but a test is preferred by us that will command an equality in respect of the predominant essential—calorific power, and not the variations that indiscriminate percentages of carburetted water gas will permit,

Where straight coal gas is distributed, then, of course, this argument against Mr. Grafton's contention loses some of its force.

Our title accuses the author of the paper of hair-splitting; and this is particularly striking in the part in which he treats of the point as to the calorific value of 14-candle gas having been fixed too high. And the reason for this view? Because the Grafton burner, with its complete air regulation, does not demand quite such high quality as does the "Metropolitan" No. 2 burner to assign a 14-candle value to a gas; and therefore, with Grafton 14-candle gas, 34 B.Th.U. gross per candle would have been all that could be demanded (or 476 B.Th.U. gross per cubic foot), as against 38 B.Th.U. per candle (or 540 B.Th.U. per cubic foot) with the "Metropolitan" No. 2 burner. In other words, the higher illuminating power is obtained by the Grafton burner from a gas poorer in the essential quality of to-day. Truly, when one considers that the 540 B.Th.U. is subjected to 7½ per cent. discount, before penalties begin to accrue, making the gas 499½ B.Th.U. gross per cubic foot—a difference of only 23½ B.Th.U. from Mr. Grafton's absolute calorific standard—we do not see that gas undertakings supplying, under the "Metropolitan" No. 2 burner, gas of 14-candle power, have, by the calorific standard statutorily prescribed, had much (if any) injury inflicted on them. Certainly gas consumers have not, in that they must obtain 23½ B.Th.U. more per cubic foot of gas burnt than Mr. Grafton would award them as a right. In this respect, in the paper, there certainly seems to be "much "ado about nothing." It is also seen that Mr. Grafton prefers a firm 475 B.Th.U. (gross) standard, and no margin, with the average of two tests in a day, if the first test is below the standard. If the suppliers of 14-candle gas could have this figure as a standard, there would be no serious objection to it. But it is a question of terms; and, in all matters legislative, it is not the desire of applicants but the ruling of Parliament that has ultimate ascendancy. As a matter of fact, the original South Suburban model did give a 12 per cent. margin, and made the penalty-line 475 B.Th.U. gross, which was as good as Mr. Grafton's estimate on his own burner could have given them. But Parliament stepped in, and brought the lower limits as near 500 B.Th.U. gross as possible, by allowing only 7½ per cent. margin. All the forces of the gas industry, including the Grafton burner, could not have prevented this.

It is perfectly evident that the author of the paper does think, and think keenly, that he has not received all the recognition that is his due in connection with the development of an argand burner which gives to gas its greatest illuminating power, and that the gas industry has failed in its duty towards itself in not adopting it as its standard burner. It is too late to consider this now. There is, however, another point that has never before been recognized; and it is the part that Mr. Grafton, through one of his burners, has taken in producing the low price of gas that rules at Widnes. Let him have the credit in his own words: "The gas supplied "in that town is tested by the writer's parliamentary standard "argand, having fifteen holes and a 7-inch chimney; and "what do we find *as the result of its use*, combined with the "able management of Mr. Isaac Carr? That gas is sold at "8d., 10d., and 1s. per 1000 cubic feet." The mystery, if ever there was any mystery about it, of the cheapness of Widnes gas is now cleared up. But we may be pardoned for thinking that we have not been altogether wrong in believing that a low capital account, no profits in relief of the rates, a supply of cheap local coal, combined with able management, have also had something to do with the matter of the low gas cost at Widnes. Mr. Carr not long ago was looking about to find how he could further reduce the cost of gas; and after studying the matter very closely, he came to the conclusion that larger horizontal retorts and heavier and longer duration charges would contribute to that for which he was seeking. Mr. Grafton now points out to Mr. Carr a very simple way whereby, without any heavy outlay, he can make a further reduction in the price of gas—that is, by adopting the Grafton "maximum value burner."

The most practical parts of the paper are found towards the end. The first refers to the use of non-luminous flame in lieu of luminous flame burners in calorimeters; and, in this connection, the author shows how, in his experiments with flat-flame burners, as used in the Boys calorimeter, he found the rate of consumption affects, to the extent shown in the paper, the calorific power of the gas per cubic foot. The use of flat-flame burners in the Boys calorimeter is most probably due more to a question of convenience in the design than to any other cause. With them a high combustion chamber is unnecessary; and the radiation of the luminous flames must have the effect of distributing the heat. On this point, Mr. J. H. Coste, in his book on "The "Calorific Power of Gas," says: "It is also probable that "the much greater radiation from the luminous burners is "an advantage as facilitating the travel of heat in all direc-"tions, and not merely in the direction of the escape of the "products of combustion." As to the concordance in calorific power results that Mr. Grafton obtained with gas burning at various rates in the Junkers calorimeter with bunsen burner, his experience has not been that of all observers. If he will look at Hendrickson's "Gas Chemist's Summary "for 1913," he will see confirmation of this assertion on p. 81. The second point is comprised in the table at the close of the contribution, in which is shown the economy to be obtained in the manufacture of carburetted water gas by more careful treatment of the oil in its gasification. This is rather a remarkable table in its lessons—the B.Th.U. per gallon column, with the first two and the two end columns, being of particular interest. Using 2·72 gallons of oil per 1000 cubic feet, and making only 370 cubic feet of gas per gallon, 227,180 B.Th.U. gross were secured per gallon; the estimated cost per 1000 cubic feet of carburetted water gas being (with oil at 3d. per gallon) 11·26d. Taking, for comparison with these figures, the last line in the table, we find this: Using 1·52 gallons of oil per 1000 cubic feet, and making 659 cubic feet of gas per gallon, 324,887 B.Th.U. gross were secured per gallon; the estimated cost per 1000 cubic feet being 6·88d. The two gases were respectively of 614 and 493 B.Th.U. gross per cubic foot; but with the latter the increase in the B.Th.U. per gallon of oil used is 97,707, with the cost per 1000 cubic feet reduced by 4·38d. Unless the gas is required for enriching purposes, there is a striking lesson here. An occasional "tuning-up" of carburetted water-gas plants, and an investigation of where economies may be secured, have been found to have good results in various works of which we have knowledge. Mr. Grafton's table, where enrichment is not the need, points to a useful line of investigation—the working to realize per gallon of oil the greatest number of B.Th.U. gross per gallon, consistent with the ordinary or the standard number of B.Th.U. gross per cubic foot of gas supplied to the consumer.

The Travancore Sands.

Mr. Hugo Hirst, the Chairman of the General Electric Company, and of about a dozen-and-a-half other concerns, is offered, in our "Correspondence" columns, a grand opportunity of distinguishing himself, and of showing his patriotism. It appears that Mr. Hirst has been speaking on the subject of this country absorbing in its home industries a larger proportion of the export business that has hitherto been done by Germany; and he sees no reason whatever why Great Britain should not start at once on the process of absorption. Mr. Thomas D. Asten, who has been dealing in our columns with the subject of the utilization by Germany of the Travancore (India) monazite sands, the useful part of which finds its way to Germany *viâ* the British-born Travancore Minerals Company (which is largely financed by the General Electric Company), suggests that Mr. Hirst could use his position to do something patriotic by helping to stop mantle exports to this country from Germany. The Travancore Minerals Company has Mr. Hirst for its Chairman. In this position, it is in the power of Mr. Hirst and his colleagues to take effectual steps to see that this country shares directly in a good provision of thorium nitrate, and to assist in reducing the supply of mantles from abroad. Progressively, home mantle factories could be brought up to a capacity equal to the whole requirements of the country; and thorium nitrate is at the root of the entire business. The gas industry is not likely to leave this matter again until it is in possession of supplies from the base in India of the material which is necessary to the gas lighting business. Movement is being made in this direction. A voluntary scheme of supply to this country would be much better than a compulsory one from high quarters. We do not think that, when the concession was made with a British registered Company, those who granted it anticipated that the benefit of sole use would be planted in Germany. Mr. Hirst wants to show a patriotic spirit. Here is an opportunity for him to make an advance.

Searching for the Correct Standard.

In an article in other columns, Mr. J. H. Fairweather, F.C.S., submits some considerations on the calorific value question which attack the view of those who think that, if a certain calorific value is given by gas suppliers, the interests of consumers are fully protected thereby. This, of course, is erroneous; and there has been plenty of published matter in the "JOURNAL" which shows any such idea to be so. But the idea is not so prevalent as our contributor obviously believes; and he has been misled by the industry's necessity for having some simple means of expressing quality in a single term in order to comply with parliamentary requirements, and the necessity has produced the custom of speaking of quality accordingly. The notion that calorific value is the *alpha* and *omega* of the qualitative question is undeniably held in quarters where the knowledge is not possessed that chemical constitution is of the utmost importance. "Calorific Value: What is it Worth?" is the heading to Mr. Fairweather's article. It is practically worth this, that it supplies us with something, without complication, which Parliament insists upon, and something which Mr. Fairweather must admit is better than the illuminating power standard and test, which takes no account of calorific value. The critic of calorific value fails us in not submitting something without complication that may be adopted in place of calorific value as a ready expressible measure of control, and so of public utility. We have a suspicion that what Mr. Fairweather would prefer for statutory control is what every gas-works should voluntarily undertake, for the purpose of ensuring an actual quality and a constant density—that is, an analysis of the gas. But as a standard of quality, a prescribed constitution of gas would never be found practicable, and would throw on to a gas-works staff unreasonable and unnecessary burdens. As our contributor mentions, not long ago Mr. Jacques Abady was pointing out that something more than calorific value was required in order to guarantee constant quality; but, answering in our "Correspondence" columns a question that we put to him at the time, Mr. Abady admitted that he would not favour the imposition of that "something more" as part and parcel of the prescribed standard.

Right and Wrong Production of Lower Calorific Value.

However, the article has two main objects. The first is that this question of calorific value in relation to constitution and service should be thoroughly and systematically explored; and the second is to show that it does not necessarily follow that a gas of low calorific power is of less value to the consumer (even disregarding the question of cost) than a gas of higher calorific value. The investigation which is advocated would, there is no question, establish the second point—that is to say, if the lower calorific value was obtained by an increase of the hydrogen content of the gas, and not by the presence of an undue proportion of inert or incombustible constituents. Mr. Fairweather's article, in dealing with the value of the lower calorific power to the consumer, is directed to making out a case for the "importance of the hydrogen content;" and he incidentally remarks that, "so long as we are dealing entirely with coal gas, any lowering of the calorific value below the 540 B.Th.U. standard must be due entirely to the presence in increased quantities of hydrogen." There is a little danger in connection with the gas industry in putting the matter that way, although the author says the article is addressed to those who know something of the technics of the questions involved. There is danger for this reason: One gas chemist in his work about the country has found that in certain cases where the make of "coal gas" has been increased to a somewhat remarkable extent, there is a deplorable percentage of incombustibles in the gas, and the calorific value has fallen very far below 540 B.Th.U. Mr. Fairweather in putting his remark in the form quoted is, of course, aware of this. Towards the end of the article, he says: Calorific value "does not even secure a constant composition or a constant quality. It does not even make sure of the absence of incombustibles."

Usefulness of Hydrogen.

But Mr. Fairweather's knowledge is not that of all responsible men in the gas industry; and we have to fight against misconceptions and practices to which the prefix "mal" could be placed in considering the interests of consumers. The increase in the hydrogen content of the gas lowers its specific gravity, as well as the amount of air required to consume it; and this increase in the hydrogen, which reduces the calorific value of the gas, has a valuable effect on flame propagation. When the velocity of flame propagation is increased, the velocity of the flow of the gas-air mixture must be greater, or there will be firing back. The article shows how the temperature of combustion for the lower calorific value hydrogen lies pretty close to that of the higher calorific value methane and carbon monoxide. The flame volume of hydrogen, too, is far less than that of any other gas; and therefore the radiation of heat is less from the smaller flame than from a larger one for a given quantity of gas consumed. So we reach the view of Mr. Fairweather that "the presence of hydrogen in increased quantities would tend to have the same result as an increased pressure of supply." He adds: "I am of the opinion that, in practice, provided the original pressure of gas was sufficient to inject the proper amount of air, the lower quality of gas would be of greater value to the lighting consumer"—that is to say, a lower calorific value gas produced by a larger hydrogen content, and not by incombustibles, which only increase the volume of heat-absorbing products of combustion, and cause the flight of heat which would otherwise be of service to the consumer. There is in Mr. Fairweather's article ground for exploration.

PERSONAL.

Mr. J. H. WEST has been appointed Gas Manager to the Lymm Urban District Council, in place of Mr. W. L. DONALDSON. Mr. West is leaving a similar position at Broadbottom, near Manchester, to take up his new appointment.

In response to an advertisement which appeared in a recent issue of the "JOURNAL," 105 applications were received for the position of Manager to the Ware Gas Company. This number was first reduced to six, and afterwards to two; the result being that Mr. FRANK PORTASS, the Works Manager at Saffron Walden, was unanimously selected to fill the vacancy.

Over a year ago, the Roscommon Town Commissioners unanimously co-opted Mr. T. M. WALSH, Manager of the Roscommon Gas Company, to a vacant seat on the Board; but Mr. Walsh did not accept the proffered honour. At the last meeting of the Commissioners, he was again co-opted to another vacancy, and then accepted the seat, saying that he appreciated the compliment very much. "The conferring of an honour such as this on a gas manager in Ireland is," says a local paper, "unique. As a matter of fact, we believe this is the first occasion for a gas manager to be elected to the position; and we heartily congratulate Mr. Walsh on holding the record, for it certainly speaks volumes as to the manner in which the Roscommon people feel as to the way in which Mr. Walsh caters for their gas wants."

Mr. THOMAS CARMICHAEL, an Assistant in the Glasgow Corporation Gas Department, has been appointed Works Superintendent at the Eastcroft station of the Nottingham Corporation gas undertaking, for which applications were invited in the "JOURNAL." Mr. Carmichael served a five years' engineering apprenticeship with Messrs. R. Laidlaw and Sons, Limited, and the Barrowfield Iron-Works, Limited, and subsequently was engaged for two years at the Tradeston Gas-Works, Glasgow (under Mr. Alex. Smith), in all branches of gas manufacture. From Tradeston he was promoted to the Chief Engineer's office, and later to the Dawsholm Gas-Works, where he superintended the erection of vertical retorts and their subsequent working. He has been seven years with the Glasgow Gas Department. Mr. Carmichael received his earlier education at the Royal Technical College, Glasgow, and has obtained first-class certificates in many engineering and chemical subjects. He also holds first-class honours in "Gas Engineering" and in "Gas Supply" of the City and Guilds of London Institute. He is President of the Scottish Junior Gas Association (Western District).

Iron and Steel Institute.—In consequence of the war, all arrangements for holding an autumn meeting of the Institute in Paris this year have been abandoned. The approved papers submitted with the view of their presentation at the meeting are to be printed, copies distributed, and discussion thereon by correspondence invited. One is by Mr. G. Stanley Cooper, B.Sc., on "The Bye-Product Coking Industry and its Relation to the Manufacture of Iron and Steel."

Examination in Gas-Fitting.—With the object of preparing candidates for the City and Guilds of London Institute examination in "Gas-Fitting" (the first of which will be held in the spring of 1915), a special course of lectures will be delivered during the session 1914-15 at the Birmingham Municipal Technical School. The teachers will be Messrs. W. E. Cadwallader, W. B. Cobb, R. G. Marsh, and A. Whitehead. Arrangements are being made so that intending students can consult the teachers, and also Mr. R. J. Rogers, the Birmingham Representative on the Gas-Fitters' Examination Committee of the Institution of Gas Engineers.

THE GAS INDUSTRY AND THE WAR.

A suggestion of the Committee of the North British Association of Gas Managers that a sum of £50 from the funds should be voted towards the National Relief Fund, was cordially agreed to at last Thursday's annual meeting. It was pointed out by the President (Mr. David Vass) that the Committee thought it a pity a sum of £90 should be lying idle, so to speak, in the bank, when some of it might be doing great work for the country at the present juncture. It was felt that the proposition was somewhat outside the rules of the Association; but members generally will certainly agree with a speaker who said "they should allow the rules to go to the wind in an emergency such as the present."

It was stated in our "Personal" column last week that, on the occasion of his departure for the front as a Territorial officer, Mr. G. R. Anderson, the Manager of the Tipperary Gas-Works, was presented by the employees with a valuable gold sovereign purse. He is not a Territorial, but has volunteered for Army service for the duration of the war, and his offer has been accepted. Mr. G. R. Anderson is the son of Mr. G. W. Anderson, of Victoria Street, S.W., who writes: "I am pleased to inform you that two of his cousins, G. J. Anderson and H. D. Anderson (sons of my brother D. H. Anderson), have come over from Bastia, Corsica, and have enlisted as privates in the 6th Dragoon Carabineers, and are now undergoing training. My late father's descendants are therefore well represented in the Army. Dr. Wm. Ainslie, of Hereford, is married to my niece (a grandchild of my father); and he has volunteered for the Royal Army Medical Corps for active service. His offer also has been accepted." The two sons of Mr. D. H. Anderson here referred to assisted their father for some time in the management of the Bastia Gas-Works.

While on the subject of family representation, it may be mentioned that three of the sons of Mr. Samuel Chandler—namely, Mr. E. V. Chandler, late of the Stock Exchange, Mr. A. B. Chandler, of the Gas Light and Coke Company, and Mr. W. J. Chandler, of the James Keith and Blackman Company, Limited—have enlisted for active service, the first in the Roughriders, and the other two in the 20th County of London West Kent Rifles.

When referring on p. 503 last week to further subscriptions to the Prince of Wales's National Relief Fund, it was stated that Mr. "A. E." Brotherton had contributed £500. It should have been said that Mr. E. A. Brotherton (who is Chairman of Messrs. Brotherton and Co., Limited, and Lord Mayor of Leeds) had promised a contribution of £5000. Readers of the "JOURNAL" will not, however, have been misled by the mistake, as the matter was correctly recorded in a paragraph appearing on the very next page. In addition to this subscription, Mr. Brotherton has made a generous offer in the Leeds City Council, which shows how great is his desire to serve his country in the hour of trial. After asking that at least 5000 men of Leeds should join the Colours, he offered to equip at his own expense a battalion to be composed of Leeds business men, to form part of Lord Kitchener's second army. The battalion, which will be known as the "City of Leeds Battalion," will, it is hoped, be about 1200 strong; and in moving a resolution of thanks to the Lord Mayor for his patriotic offer, Alderman C. H. Wilson remarked that it meant an outlay of "£6000, if a penny." The offer to raise this "business battalion" has been accepted by the Army Council.

As will be noted from our "Correspondence" columns to-day, certain gas companies have issued notices, at the bottom of which the following appears: "The company bring to the notice of all single men in their employment between the ages of 19 and 30, who are physically fit for military service and who have not yet volunteered for service with the forces, the present urgent need of their country. Those who do not volunteer for service are liable to be immediately called upon to relinquish their employment with the company, in favour of ex-service men and men too old for active service." This was accompanied by an announcement of the arrangements made by the company as to the allowances to Reservists, Territorials, and Recruits. The wives of those absent on active service will receive half the pay of their husbands, up to a maximum of 15s. per week, and an additional allowance of 1s. 6d. per week for each child under 15 dependent upon the mother. Aged parents or dependents or motherless children of men on active service will receive allowances adjustable to the particular circumstances of each case. Upon return from active service, each employee will be reinstated in the position he formerly held with the Company; and single men on their return will receive a cash bonus of not less than £5 each.

Up to the time of going to press with the "City of Birmingham Gas Department Magazine" for September, the department had furnished 174 men for active service—68 Army Reservists, 17 Naval Reservists, and 89 Territorials. Of the last named, 22 are members of the clerical staff. All employees who have thus responded to their country's call will be reinstated on the conclusion of the war; and the Gas Department will (in connection with other branches of the Corporation) make grants to dependants left at home, in accordance with a scale fixed by the General Purposes Committee. The payments to all ranks will be as follows: In the case of men whose wages did not exceed 26s. per week, 8s. for the wife and 1s. for each girl up to 16 and boy up to 14 years of age; and in the case of those who earned more than 26s. per week, half of the amount of the wages beyond this sum will be paid in addition. In the event of single men having relatives solely dependent upon them, the allowance will be 12s. per week, as no allowance is made by the Government to such dependants. Every effort will, of course, be made to prevent the combined allowances from the Government and the Committee exceeding the ordinary pay of the men before they were called up. At a meeting of the staff presided over by the Secretary and Manager (Mr. R. S. Hilton), it was unanimously resolved—"(1) That the staff of the Gas Department make a contribution each month to the Prince of Wales's National Relief Fund; and (2) that this meeting recommends members of the staff to act upon the suggestion of the Benevolent Fund Committee, to the effect that they should contribute at least 2½ per cent. of their gross salaries."

The following additional contributions to the National Relief Fund have been noted: Ebbw Vale Steel, Iron, and Coal Company, Limited, £1050; Wandsworth, Wimbledon, and Epsom District Gas Company, £1000; Southgate and District Gas Company, £262 10s.; Brentford Gas Company, £250; Walter Cliff, £250; William Tangye, £250; Bishop's Stortford, Harlow, and Epping Gas and Electricity Company, £105; Hastings and St. Leonards Gas Company, £105; Woking Water and Gas Company, £105; Matlock Gas Company, £50; Shrewsbury Gas Company, £50; Lewes Water Company, £21.

Reference has already been made to the early extinguishing of the lights in the cafes, restaurants, and entertainment houses of Paris. The lights in the streets are also extinguished at an early hour. The Paris Correspondent of the "Daily Telegraph," writing last Tuesday said: "Since the advent of M. Millerand as Minister of War many regulations have been changed, and while some increase our liberties, others are of some momentary inconvenience, but wisely taken, nevertheless. One of these is the putting-out of the lights in the principal squares and avenues as early as eight or nine o'clock at night. The measure on the first two nights (that is, Sunday and Monday) created some embarassment to people who had to be out late. Paris, with all its avenues and its bridges over the Seine plunged in obscurity, was like a child in the dark—it was frightened. But like a child, it went to sleep and forgot its fright. The measure was no doubt a good one. Now that the enemy's flying machines come scouting over the city, there is no reason why its principal squares, public buildings, and avenues should be shown to them by brilliant illumination. Besides, if it should ever come to a siege, which we do not believe will ever be the case—still, it is better to be provided beforehand—it is an idle waste of gas and coal to keep such profuse lighting going as is the custom in time of peace. The coal had better be hoarded-up and kept for the bad days if they should ever come."

A different condition of things exists in Brussels. Since the German occupation of the city, a proclamation orders that the inhabitants must keep their houses lighted all night. Whether inhabitants and suppliers of gas and electricity will be pleased, we cannot say.

The consumption of gas and electricity by public houses in London is to be reduced; for in the general interests these houses are (as from yesterday) to be closed at 11 o'clock.

The patriotism of the Southgate and District Gas Company, and of their Manager (Mr. John Mitchell), has been exemplified by a fillip given to the employees to enlist. A little company of 43 smart-looking fellows, including all the single men, were given a ringing cheer by the remaining employees, as they swung out of the premises last week *en route* to the recruiting office at Wood Green. Two days after the declaration of war, the Manager posted up in the works a notice headed by his own name, appealing for men to sign a paper offering their services in case of emergency. Within four days a rifle range was upon the premises, and fifty men who had "signed on" were busy getting bulls-eyes. A professional drill instructor was appointed; and he has put the raw recruits into shape.

The Manchester City Council have approved of the offer of the Gas Committee (already recorded in this column) to contribute out of their reserve fund £10,000—£7000 to go towards the equipment of a Manchester Battalion, and £3000 to the Lord Mayor's Local Relief Fund. Several members of the Council expressed the hope that the example of the Gas Department would be emulated by other departments of the Corporation who have the means at their disposal.

The Chief Constable of Lancashire (Mr. H. P. Lane) has warned the public that all water-works in the county are guarded by armed police, and that any unauthorized person approaching or trespassing on the works will render himself liable to be fired at. "All persons," says the notice, "are warned to keep at a distance from any reservoir, pipe-track, or water-course, and on no account to loiter in the vicinity." Many of the reservoirs in Lancashire, says our Manchester Correspondent, are guarded

by special constables, who have been sworn in for the occasion. Some of these constables act gratuitously, while in the more important districts the pay varies from 4s. to 6s., from 6 p.m. to 6 a.m.

Acting in a highly commendable and patriotic manner, the workmen and staff of Messrs. C. & W. Walker, Limited, of Donnington, have intimated to the management that they would prefer to forego their annual outing, and have requested that the donation usually given by the firm for this purpose be devoted towards one of the funds that are now being raised for the relief of distress in the present crisis. It is understood that the Prince of Wales's Fund was to receive about £60, and the Red Cross Society about £15. The men's action is much appreciated in the district. The Directors have also sent a donation of £160.

About 8 per cent. of the men employed at the West Bromwich Gas-Works have gone to serve their country; and the following resolution has been passed by the Council: "That the salary or wages of every employee of the Corporation serving in the Army and Navy and having persons dependent on him shall be paid to him or his dependents or representatives, less the amount of his Army pay and the separation allowance (if any) of his dependents, provided that the total amount received shall not exceed his salary or wages; that there shall be paid to every employee of the Corporation serving in the Army and Navy and not having any persons dependent on him a sum of 5s. per week, and such sum shall be retained by the Corporation for him or be paid to such person or persons as he may nominate; that every such employee as aforesaid shall be reinstated in the service of the Corporation on his return from the war."

The General Purposes Committee of the Ossett Corporation have passed a resolution that all employees on active service shall be paid at the following rates as long as the war lasts, and their places be kept open for them: Single men, 7s. 6d. per week; single men with dependents, 12s. 6d. per week; married men, 12s. 6d. per week and 2s. 6d. per week for each child. This is the minimum scale adopted; and a Sub-Committee has been formed to increase the amounts, if necessity in any case arises.

It was unanimously agreed at the half-yearly meeting of shareholders in the Farnworth Gas Company that a sum of £100 should be given for the relief of local distress, at the discretion of the Directors, when they thought necessary. The officials and men have also decided to contribute sums weekly from their salaries and wages.

At the meeting of the Woking Water Company last Tuesday, it was decided to contribute 200 guineas to the National Relief Fund and the Local Distress Fund; the division of the amount between the two funds to be left to the discretion of the Directors.

The Directors of the Shanklin Gas Company have unanimously decided to make up the difference between the Government allowance and full wages to all employees who have been called to the Colours, and also to keep their places open for them, and to treat absence with the flag as continuous service with the Company. They will keep open the berth of any young man now enlisting until he is able to return. It has been unanimously agreed by the employees to subscribe a sum equal to 2d. in the pound per week until the end of the war from all salaries and wages paid by the Company, which sum is to be paid monthly to the National Relief Fund, the Local Treasurer of which is Mr. Frank C. Taylor, the Engineer and Secretary to the Gas Company.

A Corporation service scheme of contribution to the National Relief Fund has been adopted by everyone employed by the Nelson Gas Department; and the deductions will be made by the Treasurer when paying salaries and wages. The weekly contributions will be: For those earning under 10s. per week, 1d. per week; 10s. and under 20s., 3d.; 20s. and under 30s., 6d.; 30s. and under 40s., 9d.; 40s. and under 50s., 1s.; 50s. and under 60s., 1s. 3d. For officials the scale is: 60s. per week and under £200 per annum, 2¾ per cent.; £200 and under £300 per annum, 3 per cent.; £300 and under £400, 3¼ per cent.; £400 and under £500, 4 per cent.; £500 and upwards, 5 per cent.

At the half-yearly meeting of the Worthing Gas Company, the proprietors unanimously approved of a proposal by the Directors to vote 100 guineas to the War Relief Fund—this sum to be applied equally between the Prince of Wales's Fund and the local fund. Nine of the Company's employees have at present joined the Colours, and their places are being kept open for them on their return. The Directors are also paying the wives of the married men half their salaries.

The Directors of the Whitby Gas Company have arranged to pay 10s. per week to the wives of employees who have been called up on military or naval service, and to reinstate the men on their return.

A number of the employees of the Ilford Gas Company have gone to the front; and the Directors have made arrangements that they and their families shall not suffer any pecuniary loss by their patriotism, and that their places shall be kept open until they return.

Eleven out of fifteen of the Tonbridge Gas Company's fitters had at the time of the recent meeting of shareholders been called up for active service, and another employee was just leaving. The Directors have decided to pay the married men the difference between their pay and the wages they would be receiving were they at work. Mr. J. Donaldson (the Manager and Secretary) has received interesting letters from some of the men; and one and all, said the Chairman to the shareholders, spoke of the kindness they had received at the hands of the Manager.

The following scale of contributions to the Leeds National Defence Fund has been decided upon by the officials and workmen employed by the Corporation Gas Department: Under a wage of 15s., 1d. per week; 15s. and under 25s., 2d.; 25s. and under 30s., 4d.; 30s. and under 40s., 6d.; 40s. and under 50s., 9d.; 50s. and under 60s., 1s.; 60s. up to £250 per annum, 2½ per cent.; over £250, 5 per cent. The employees of the Normanton Gas Company have voluntarily decided to contribute 6d. per week to the Prince of Wales's Fund.

The workmen at the Darwen Corporation Gas-Works have arranged to make weekly contributions in aid of the local Relief Fund. The contributions are to be proportionate to the salaries received; Mr. A. H. Smith, the Engineer and Manager, heading the list with 7s. 6d. per week as long as the war lasts.

In the cases of the wives of Blackburn Corporation Gas Department employees called up for service in the Navy, Army, or Territorial Forces, the amount of their separation allowances, together with half the service pay of the man called up, will be made up to three-fourths of the present pay, with a minimum of 20s. Where there are no children, the amount will be 5s. per week less than this, with a minimum of 15s. The cases of unmarried men called up is referred to the Mayor and Mr. Holgate to consider and report upon; and the places of all such employees are to be kept open for them until the termination of the war. The officials of the Gas Department have decided to contribute from 2½ to 5 per cent. of their salaries to the Mayor's branch of the Prince of Wales's Fund during the continuance of the war.

Speaking at the half-yearly meeting of the Maidenhead Gas Company, Mr. J. W. Walker said that seven of their men and one of the Directors had gone to the war. Provision would be made for the wives and families left at home.

A concert organized by the Reading Gas Company's Club realized £7 for the National Relief Fund. Mr. D. H. Helps (the Engineer and Manager), who presided, said that the Company were offering every facility to young men in their employ who wished to volunteer for active service; and he had no doubt that they would find their places open for them on their return. A large number of the men had already joined.

The Bradford Corporation Gas Committee have decided to give 20,000 bags of coke, delivered free, for distribution among the poor of the city.

In view of the stoppage to the importation of Continental-made glassware, "Holophane Limited" write to point out that theirs "is the only form of prismatic glass which is made in this country." Their works at Gateshead are well-equipped for dealing with any demands which may be made upon them; and it is not anticipated that any difficulty will arise in regard to the supplies of raw material.

Owing to the limited stock of carbons required for arc lamps, and the difficulty of obtaining supplies (the manufacture of these carbons being chiefly confined to Germany), the Dublin Corporation Electricity Committee have curtailed the lighting hours. Each alternate arc lamp in the city streets is now extinguished at 11.30 p.m.

The officials of the Halifax Corporation who are in receipt of salaries of £250 per annum and over have decided to request the Corporation to deduct 5 per cent. from their salaries, and to pay the amount to the Mayor's Relief Fund.

The following resolution has been passed by the Chadwick Trustees: "That, in view of the immense importance of encouraging in every way the promotion of careful sanitary organization in the Naval and Military services during the present campaign, the Chadwick Trustees have resolved, under the powers conferred upon them under the scheme they administer, to announce their intention to award at the close of this year, the 'Chadwick Gold Medal' and £50 each to the Naval and Military Medical Officer respectively in the British Service who shall have distinguished himself most in promoting the health of the men in the Navy and the Army. The nomination for such presentations to be, as provided by the terms of the Trust, by the Directors-General of the Naval and Military Medical Services respectively."

NATIONAL GAS EXHIBITION.

The Recent Appeal for Funds to Meet the Deficit.

We are asked by the Hon. Secretary (Mr. Walter T. Dunn) to publish the following (first) list of responses received to the appeal issued for contributions towards the deficit in the accounts of the National Gas Exhibition. It is hoped that the prompt and liberal action of those who have thus responded will assist managers in persuading their boards and committees to add their names to the list.

Further Contributions from Undertakings which have Previously Subscribed.

	£	s.	d.
Banbury Gaslight and Coke Company	1	1	0
Barnard Castle Gas Company	1	1	0
Bath Gaslight and Coke Company	10	0	0
Bridgwater Gaslight Company	2	2	0
British Gaslight Company, Limited	100	0	0
Cork Gas Consumers Company	2	2	0
Crowborough District Gas Company	1	5	0
Croydon Gas Company	36	4	0
Denbigh Gas and Coke Company, Limited	1	1	0
Dewsbury Corporation Gas Committee	1	1	0
Halstead Gas Company, Limited	0	10	6
Hatfield Gas Company	0	10	6
Ilford Gas Company	15	0	0
Isle of Thanet Gaslight and Coke Company	5	5	0
Narborough, Blaby, Enderby, and Whetstone Gaslight and Coke Company, Limited.	2	2	0
Redcar Gas Company	5	0	0
Rhymney and Aber Valleys Gas and Water Company	2	0	0
Sleaford Gas Company, Limited	2	2	0
Tottenham District Light, Heat, and Power Company	25	0	0

Contributions from New Subscribers.

Bewdley Gas Company, Limited	1	1	0
Blackpool Corporation Gas Committee	10	0	0
Finedon Gas and Coke Company, Limited	2	2	0
Sandbach Gas Company	1	1	0
Warminster Gas and Coke Company	3	3	0
Wimborne Minster Gas and Coal Company, Limited	1	1	0

Further Contributions from Manufacturers.

Consett Iron-Works	5	0	0
G. A. Williams, Gas Engineer	5	5	0

RETIREMENT OF MR. W. A. WALKER.

It has been the privilege of Mr. W. A. Walker (whose retirement from the post of Engineer and General Manager to the Worthing Gaslight and Coke Company has, as mentioned last week, been marked by the granting of a retiring allowance of £250 a year) to witness a remarkable growth in business during the thirty years he has held the post; and it is also his proud boast that during this period the works have been practically reconstructed without any outside professional aid of any kind, and without his Company being required to expend a penny on outside assistance. At the present time, the Worthing Company possess about 38 miles of mains; and whereas the output of gas during the first year of Mr. Walker's service with the Company was only 39 million cubic feet, it has now increased to more than 200 million cubic feet, while the number of consumers has grown from 1150 to 6700, and the coal carbonized has risen from about 4000 tons to 18,000 tons a year. The financial position of the undertaking has also expanded in a corresponding degree. The capital employed in it thirty years ago was only £56,250; it now stands at £136,196, *plus* £38,662 added by consolidation. The price of gas to the consumer has been reduced from 4s. 9d. to 3s. 3d. per 1000 cubic feet; and the increased use made of gas for cooking purposes is illustrated by the fact that, while there were only about 50 stoves in use when Mr. Walker went to Worthing, there are now no fewer than 5350. The proportion of gas supplied for cooking and heating is quite as great as that required for lighting purposes locally; and Mr. Walker could point to several occasions recently when the quantity used for cooking during the maximum period was actually greater than at any hour of the evening, with all the shops lighted.

Mr. Walker has been actively connected with the gas industry for 48 years; and his responsibilities have been great for most of the time, demanding a full display both of physical and intellectual vigour. Thus his desire is natural to loosen the bonds at a time when he possesses the capacity to enjoy the leisure now made possible to him. Born at Elland, in the West Riding of Yorkshire, he commenced the serious business of life at a very early age; for in 1866, while in his teens, he secured employment in the gas-works in his native town. So gratifying was his advancement, that eight years after he entered the service of the Company he was occupying the position of Secretary and Manager. This represented the period intervening between 1877 and 1884; and in the latter year he went to Worthing.

ELECTRICITY SUPPLY MEMORANDA.

We learn from "Electrical Industries" that the gas industry is in a painful muddle, and that now, in the crippled condition in which the industry finds itself, is the time for the electrical industry to make a vigorous onslaught on "the declining remnant of gas consumers." Never—before or since the advent of electric lighting—has the "remnant" been more bulky in number or more generous in patronage than it is to-day. Some electrical people seem to comfort themselves by, and to find joy in, the most hollow pretence. Our imaginative friend of "Electrical Industries" is one of them. It seems from our contemporary that a perfect storm (traceable to the war) has gathered in the gas industry over the mantle business, while over the electrical industry in connection with electric lamp supplies there has only passed the merest ripple. This country, the truthful commentator says, does not rely largely upon the Continent for tungsten for the making of metallic filaments. He omits all references to the bulbs, and does not hint even at arc lamp carbons. He should apply to the General Electric Company for a little more information on the nitrate of thorium question; and he would find that that Company is concerned in the Travancore Minerals Company—unless Somerset House has misinformed us—and so is interested in a large contract between the Travancore Company and the owners of the Osram lamp in Germany for the supply of the thorium nitrate with which they make a considerable contribution to the gas-mantle supply of the world. Our friend would derive an immense amount of interest from his investigation. He would find, for instance, that the world is not dependent upon India alone for monazite sand. A large quantity comes from Brazil; and there is a deposit in North Carolina. What the British gas industry complains of to-day is that the sands richest in thorium should be taken from India and its useful part be landed in Germany, *viâ* the Travancore Minerals Company. While the British gas industry is looking into this matter, it does not find itself in a corner. That nitrate of thorium got largely into the grip of Germany through its masterly organizations and commercial connections, is not much (if any) more astonishing than that so much of the electrical business in this country has produced profit for German capital. Exports of gold to Germany by the electrical industry have been considerable. However, there is ample nitrate in this country, through the enterprise of the South Metropolitan Gas Company and the stock in the hands of certain of the mantle makers, to meet all requirements during any length of time the war may continue. Most gas undertakings throughout the country have also plentiful stocks of mantles; but tradesmen may not be so well off. As to ramie, if necessary we must fall back on cotton; a cotton base for mantles was the common practice at one time. Our electrical friend need not worry himself. The gas industry is in no difficulty that gives any opportunity "for a vigorous onslaught upon the declining remnant of gas consumers." If he finds any comfort in fiction, he is welcome to all that he can derive from it. But, please, do play the game. The daily papers have been full of evidence of hypocritical dealings lately; we do not want any more of it in weekly technical papers.

Information from Outside.

Vesey Brown—Hot Water Engineer.

A poor opinion of the knowledge of some other people appears to be entertained by Mr. C. S. Vesey Brown. The inclination to this view on our part has been produced by an article he has contributed to the "Electrical Times" on the "Electric Heating of Water," and which contains a large amount of purely elementary matter, of which electrical engineers, we had imagined, were in full possession. He sets out by stating that the term "hot-water engineer" is a cloak covering much that is not, strictly speaking, engineering. It might be said that the term "electrical engineer" is also used as a cloak for nescience, and much that is not engineering. There are a lot of men who profess and call themselves electrical engineers who are nothing of the kind. All electrical engineers, too, are not hot-water engineers. For example, after reading Mr. Vesey Brown's article, we should not, in our own interests, good as he may be as an electrical engineer, entrust him with a hot-water engineering job, unless maybe it was a very simple affair, and then it would be stipulated that he should not use electricity. From an elevated position, Mr. Vesey Brown views, through a telescope inverted from the normal, some of the people—such as architects, builders, plumbers, and ironmongers—who have hitherto been existing in the belief that they are serviceable in the world's work, and are not altogether devoid of knowledge and commonsense. Their electrical critic finds that such people as those named are not, as a rule, conversant with the physical principles involved in the transmission of heat, and any idea of efficiency in heat units never enters into their heads, and therefore are omitted from their calculations. Certain of the hot-water engineers with whom we are acquainted knew a great deal about the physical principles associated with their work, as well as about thermal efficiency, long before Mr. Vesey Brown had given any serious thoughts to these matters. We also rather think that certain of the intricate hot-water supply installations that have been made by some of

these men, who have adopted gas or coke as the heating agent, would have knocked Mr. Vesey Brown off his perch had he been originally confronted by them as propositions requiring practical treatment. Knowledge of the physical principles involved in the transmission of heat, and being able to calculate how many B.Th.U. will be required to do a prescribed amount of work, assuming a given efficiency of apparatus, and knowing the starting temperature of the water, are only part of the necessary accomplishments of the hot-water engineer. Then Mr. Vesey Brown proceeds to occupy about five columns of our contemporary in, for the greater part, telling electrical engineers of numerous small points about which they ought previously to have been fully acquainted. If they were not formerly acquainted with them, they ought to be ashamed of themselves. Let us give one example:

> The temperature of the first [boiling water for tea, coffee, &c.] is easily distinguished, and the quantity is relatively small per diem. It can be handled by self-contained kettles of two, three, or four pints capacity, depending on the persons to be supplied, and by proper plug attachments the water can be boiled where it is required to be used—*i.e.*, kitchen, dining-room, bedroom, &c.

What profound knowledge is displayed there! Electrical engineers will no doubt be mightily interested to learn that water for tea and coffee can be boiled, in two, three, or four pint kettles, the size of the kettle varying according to the number of persons to be supplied, and that where the means exist the water can be boiled in the "kitchen, dining-room, bedroom, &c."

Separate Heaters for Different Purposes.

There is much of the simple and elementary order in the article. Divesting it of all this, and coming to its real kernel, it is found that Mr. Vesey Brown proposes that domestic hot water provision by electrical means should be separately arranged according to requirement. He finds that water at 145° Fahr. will remove the most adhesive grease or clean the dirtiest floor; and that 104° Fahr. is a temperature quite high enough for his bath. The separate local treatment, of course, is proposed, because electrical operation cannot afford to lose any heat by an ordinary circulating system—the expense and slow action of electrical operation, unless an extraordinary high loading is provided (which is not practicable in the ordinary household) being both against it. He does not describe the apparatus he would use, nor the question of installation and maintenance charges in connection with the separate system of water heating for each purpose. We had a little water-heating proposition before us recently, in which a coke-heated boiler is used simply affixed to the ordinary water-circulating system. There are two bath-rooms in different parts of the house, hand-basins in two lavatories, and hot water supply in both the kitchen and the scullery. It would be a little expensive to fit up a house of this kind on Mr. Vesey Brown's plan, in which probably three or four people have a warm bath nearly every morning of the year, and occasionally after tennis and golf. Even for smaller houses, the electrical system on the separate principle would be expensive; and in those houses a difficulty would be that in the main the tenants are not the owners of the houses, and so would not care to incur the outlay or obligations that would be entailed by such a scheme. So far as we can see, too, Mr. Vesey Brown puts by the electrical method a limit on the temperature of water that he allows the user to have. Passing over some more deeply erudite information as to the number of B.Th.U. that there are in a Board of Trade unit, as to there being a difference in the initial temperature of water between winter and summer, and as to more B.Th.U. being required to raise the colder water in winter to a given temperature than to raise the initially higher temperature water in summer, we come to these inquiries: "*En passant* [a term much favoured by the Little Peddlington reporter] one may ask the question, Can any consumer of gas measure a cubic foot?" The answer is he can if he likes. "Does he know what it means?" The answer is that he must be an ignoramus if he does not. Anyway the consumer knows more about what constitutes a cubic foot than he does about what constitutes a unit of electricity. "Has he [the consumer] any idea of the calorific value of gas?" The answer is that he does not trouble his mind about it any more than he does about the calorific value of the coal or coke that he uses; but Parliament is now seeing that the consumer gets a prescribed calorific value per cubic foot—usually 540 B.Th.U. What the consumer does know is that from a pennyworth of gas he can realize a greater quantity of heat than from a unit of electricity at what is deemed to be a commercial price by electricity supply undertakings. And the last stupid question is, Does the consumer know what quantity of air is required to give perfect combustion? We do not for a moment suppose he does, nor does he trouble his head about it. Gas-stoves are now provided with the means of air-regulation; and the fitter regulates them to suit local conditions.

Requirements and Miraculous Efficiencies.

It has been pointed out that Mr. Vesey Brown favours bath water at 104° Fahr., so that 114° Fahr. should be allowed at the heater, owing to the cooling action upon the water of the bath material. Taking the average temperature of the inlet water at 55° Fahr., it would thus be necessary to raise the water 60° Fahr.; and assuming 25 gallons of water for a bath, Mr. Vesey Brown calculates a use of 4·4 units per bath or 5½ units in winter. He indirectly asks us to believe that the efficiency of electrical water-heaters is of the 100 per cent. order, and that there is no waste of heat by radiation, convection, or in any other way. That is asking too much. If only one 25 gallon bath of water per day is required, then he says that a 200-watt loading will suffice. We say that Mr. Vesey Brown (who has had a tilt at the ignorance of others on physical principles and heat efficiency) will not with any 200-watt loading, in 24 hours on a winter's day, raise 25 gallons of water from the temperature in the inlet water-pipe to 114° Fahr., and place it in the bath with a temperature for the bulk of 104°. Throughout the day, especially in winter, heat will be escaping from the storage vessel; and, apart from that, in 24 hours every B.Th.U. of the 4800 watts, without any loss, could not possibly do the work. Then comes a confession: "If more than one bath is required, then the electrical system installed fails; if the use of the bath is missed one day, the piling-up of temperature during that day is so much waste." To guard against this, he advises the installation of "a very careful thermostat arrangement." Even with a thermostat, supposing there is no withdrawal of water, losses of heat lead to the intermittent necessity for some additional current; so that there cannot possibly be the 100 per cent. efficiency that Mr. Vesey Brown claims. He proceeds:

> The solution, as far as baths are concerned, appears to lie between a thermostatically controlled low-loaded 400 to 500 watt heater with limited water storage and the instantaneous heavy-loaded heater (10 to 15 kw.) with unlimited capacity. It lies with the supply authorities to consider whether they will allow the consumer facility to freely draw off hot water through (say) 15 kw. heaters, or to confine him to the narrow limits of a storage tank and low-loaded heater which may fail him just at the critical moment; also experience of the vagaries of the kitchen boiler may be repeated.

There is not much chance of many 15 kw. water-heaters being fixed—for more than one reason. And Mr. Vesey Brown should know this. Regarding the kitchen supply at 145° Fahr., the instructor of the electrical profession in physical principles and heat efficiency as affecting hot-water supply says that data taken in a house with six persons seem to indicate that an average of 7 to 10 gallons of water at 145° Fahr. are required per diem, drawn off in varying quantities, from ½ to 1½ gallons, depending on the use to which it is put. Taking 10 gallons at an average rise of 90°, this means 2½ to 3 units per diem or (say) 120 watts per hour. Therefore, we see that for the water for one bath per day and 10 gallons of water for kitchen use, giving the appliances credit for 100 per cent. efficiency, and not allowing a single unit of heat to stray from the water, the cost at 1d. per unit would be 8d. or 9d. per day, or at ½d. per unit 4d. to 4½d. Assuming theoretical thermal efficiency in practice, at 4½d. per day this modest hot-water supply alone would cost £6 16s. 10d. a year, and double this if 1d. per unit were charged. A bath of water can be obtained, with gas at 2s. 6d. per 1000 cubic feet, for about 1d., and that promptly, and as many baths in a day as members of a family require. But in the result, there is indication of doubt in Mr. Vesey Brown's mind. He writes:

> Even if a definite quantity of (say) 50 gallons per day, at an average temperature rise of (say) 70° overall, supplies (outside of boiling water) could be depended on, the annual cost, at a fixed rate of ½d. per unit, would be in the region of £7 10s.; and it is doubtful if consumers can be got to pay this amount as a standing charge.

It is doubtful; and this is not the only point that raises doubt in our mind regarding the electrical heating of water for domestic purposes.

Two Views on the "Half-Watt" Lamp.

There are divergent views in the electricity industry on the subject of the half-watt lamp. Its price is too high, or its consumption-reducing power is too heavy, to appeal to electrical engineers, except for purposes such as shop-lighting, where it supplies something new about which to talk, and to get adopted as a novelty. But electrical engineers keep clear of the intrinsic brilliancy question as illustrated by these lamps. It is too knotty a point for them to tackle, though they know full well that they are doing wrong in putting up these lamps without screening the filaments from the human eye. But to the two official views on the lamps. In the annual report of the Glasgow Electricity Department, there appears this statement: "Experiments are being made with the half-watt lamps in connection with street lighting; but the obstacle in the way of a general adoption of the lamp is said to be the somewhat high price paid." The other view comes from the Electrical Engineer of South Shields. In his annual report, he says the half-watt lamp has enabled the department to obtain many consumers for outside shop lighting who were previously apparently satisfied to be without the light altogether. Then he significantly adds that, although he welcomes the high power half-watt lamp, he would not welcome to the same extent a similar low-candle power one, as such a lamp is not needed to enable the concern to compete for inside lighting; and it would have a serious effect on the revenue.

Mr. John Chew, of Blackpool, whose death was announced in the "JOURNAL" for the 16th of June, left estate of the gross value of £24,039, with net personalty amounting to £19,105. Among the bequests is a sum of £50 to his "faithful foreman," Robert Topping.

CALORIFIC VALUE: WHAT IS IT WORTH?

THE IMPORTANCE OF THE HYDROGEN CONTENT.

By J. H. Fairweather, F.C.S.

Recent speeches at company meetings would almost make it appear as if, in applying to Parliament for a new standard of supply, it was solely and entirely the duty of the company to go for something that was to give to their shareholders greater profit. It is gratifying, therefore—since it is more in line with the general terms of the gas company monopoly and commercial principles—to find the "Journal" saying some time ago that "it was the duty of gas manufacturers to place themselves under a standard that was of value to their customers." I have no doubt that it it was on these lines that certain large companies applied to Parliament during the present session, and obtained the calorific standard. The figure placed upon this standard has been largely criticized. If it is the case that as a standard it is of greater value to the consumer, we shall be agreed that the enhanced value should not be at the expense of the shareholders' profits. It is with this question of value that I wish to deal.

We have been told that all modern uses of gas necessitated that it should be a heating agent, and therefore the only sensible standard is a calorific one—an argument so delightfully simple that further inquiry seems to be useless. Further, it has been said "that the desirable object in every case is to enable the undertaking to supply the greatest number of heat units at the lowest possible cost," and the future lies with the man who can do this. We shall be agreed as to the consideration of quality relative to cost; but is calorific value really a measure of this quality? Is it something that tells the consumer of the value of the gas to him, or is it simply a scientific figure with no definite counterpart in practice, presuming always that the consumer uses the most perfect instruments? I have yet to learn that any such inquiry has been made; it has been taken very much for granted.

Some experimental investigations seem to have been made into the comparison of results in an incandescent burner between gases of high and low candle power; but this is hardly what is wanted. Even then, with different observers the results have been widely different, and, in fact, have shown little appreciation as to what were parallel conditions. I regard the results as of no value whatever; and it is significant that practically no information of this kind was given to the Parliamentary Committee.

It does not necessarily follow that a gas of low calorific power is of less value to the consumer, even disregarding the question of cost. The men who have paid most attention to the matter know this to be the case. Mr. Jacques Abady, at Liverpool, recently said: "There is more value in a cubic foot of gas at the higher than at the lower pressure;" and "I suggest you want something more than calorific value to ensure that you are getting a constant quality." These things we know to be true. Other men have repeatedly brought forward conditions affecting the actual quality of the gas to the consumer; and it is by examining and placing together the results of experience and investigations that we shall eventually arrive at what is a real standard, and which gas forms the best supply. At present we are largely in the dark, and possibly consumers and companies alike are suffering as a result. From the information available, it is more than likely that one quality gas is not best for all purposes. In this case a compromise would have to be made; the lighting consumers always having first claim.

Calorific Value in Lighting.

As a plea for an inquiry into the practical aspect of calorific value, I propose to set out a few of what I conceive to be considerations involved in incandescent lighting. Unless with the co-operation of a large gas company this investigation is not open to the ordinary observer. At the outset it will be convenient to give the calorific values of the different gases that can be present in a public supply. These are variously stated by different authorities. The following figures are taken from Damour's "Industrial Furnaces;" calories per molecular volume being multiplied by 5 to convert them into B.Th.U. per cubic foot:—

Calorific Power.

	Gross. (Liquid.) B.Th.U.		Net. (Vapour.) B.Th.U.
Hydrogen	345	..	291
Carbon	—	..	147
Carbon monoxide	—	..	341
Methane	1068	..	976
Acetylene	1579	..	1525
Ethane	1862	..	1700
Ethylene	1706	..	1598

This article is not addressed to the general public, but to those who know something of the technics of the questions involved. Therefore, without going into the reasons, certain things can be simply stated. For instance, so long as we are dealing entirely with coal gas, any lowering of the calorific value below the 540 B.Th.U. standard must be due almost entirely to the presence in increased quantities of hydrogen. In other words, in what we now call the lower quality gas there is a greater proportion of hydrogen to the other constituents. The result of Mr. Goulden's experiments on increased makes, as communicated to the Eastern Association of Gas Managers toward the end of last year, was, I think, that the 15,800 cubic feet make, as compared with the 12,000 cubic feet make on the same coal, increased the hydrogen content by approximately 12 per cent. The increase lowers the specific gravity and the amount of air required to consume the gas. The change in composition is more clearly shown by the following table:—

	12,000 Cubic Feet Make.		15,800 Cubic Feet Make.
Hydrogen	53 per cent.	..	65 per cent.
Other constituents	47 ,,	..	35 ,,
Other constituents to hydrogen are as	1 : 1·17	..	1 : 1·86
Air for combustion	(approx.) 5·1 volumes	..	(approx.) 4·3 volumes
Specific gravity	—	..	(approx.) 0·04 less
Calorific value	—	..	(approx.) 65 B.Th.U. less

[Stripping gas with oils, as I know has been done in comparative tests on results in an incandescent burner of gases of different illuminating powers, affects the composition far differently, and vitiates the results.]

This changing proportion of hydrogen, apart from the loss of heat units, is extremely important. In the incandescent burner gas is burnt mixed with air in the proportion required to consume it, or as near to it as can be obtained. One of the deciding factors so far as the resulting flame is concerned is the velocity of explosion of this gas-air mixture, or the rate at which the explosive flame propagates through it. There can be no flame from the burner-head unless the velocity of flow of the gas-air mixture is greater than the velocity of the propagation of its explosive flame; for, of course, under such a condition the flame would simply rest on the burner head, heat it, and strike-back. The rate of this explosive propagation of flame is not the same for all gases mixed with air, or for different proportions of the same gas with air, as the following tables, from the classical experiments of Mallard and Chatelier, will show:—

Velocity of Explosion of Hydrogen with Air.

			Metres per Second
2 volumes of hydrogen with	8	volumes of air	2·0
2 ,, ,, ,, ,,	6	,, ,,	2·8
*2 ,, ,, ,, ,,	$4\frac{2}{3}$	,, ,,	3·4
2 ,, ,, ,, ,,	$3\frac{1}{2}$	,, ,,	4·1
2 ,, ,, ,, ,,	3	,, ,,	4·4
2 ,, ,, ,, ,,	2	,, ,,	3·8
2 ,, ,, ,, ,,	$0\frac{2}{3}$	,, ,,	2·3

Velocity of Explosion of Coal Gas (Practically Half Hydrogen) with Air.

1 volume of coal gas with	7·0	volumes of air	0·83
*1 ,, ,, ,, ,,	5·6	,, ,,	1·00
1 ,, ,, ,, ,,	4·7	,, ,,	1·16
1 ,, ,, ,, ,,	4·0	,, ,,	0·90

* Theoretical proportions of air.

The rate of the explosion of hydrogen is ten times that of other gases, and changing proportions of air do not affect it to the same extent. It will be seen that with hydrogen the air has to be reduced to practically three-quarters the theoretical amount before there is any lowering in the explosive rate, and that halving the amount of air very much increases it. With ordinary coal gas the explosive rate is found to be reduced by a restriction of air by one-fifth.

For the importance of this, and without going too much into technical detail, it will be necessary to understand a little of the mechanism of the bunsen burner. Gas immerges from two or three small holes in the nozzle of the burner at a velocity determined by the pressure of supply and the density of the gas. This impinges on a body of air having no velocity, and the impact brings about the injection of air, which mixes with the gas; the mixture being delivered to the burner-head at a much less velocity than the original velocity of the gas. What it is exactly is dependent upon the amount of air injected and the momentum of the gas immerging from the nipple; also to a large extent upon the friction losses within the burner.

It is a fact that the ordinary pressures of supply will not enable the theoretical quantity of air to be injected, if the air-gas mixture is to be delivered to the burner-head at a rate in excess of the striking-back rate. Therefore, in practice a compromise is arrived at by restricting the air to something less than is theoretically required. In such a case the flame depends for its completion upon the extraneous atmosphere. It is therefore drawn out to a greater volume, and its heat intensity becomes less, affecting to a large extent the luminosity of the mantle. Restricting the air, does two things:

(1) It increases the velocity of the gas-air mixture to the burner-head.

(2) It decreases the striking-back rate.

But, as an examination of the foregoing tables will show, the point at which these two things effect a compromise is largely dependent upon the hydrogen content of the gas; and in all probability there has to be a greater degree of restriction in the air with the lower quality gases. In practice it very often happens that a better light is obtained by further shutting-down the air sleeve. This is due to the still less intense flame shaping itself better to the mantle. The fact that in all circumstances we must have the same flame volume introduces many fresh complications, which are more or less obvious.

With all these different factors to consider—especially that of

the changing explosive behaviour in the different grades of gas—it would seem that when gases are burnt in the incandescent burner at a less pressure of supply than is necessary to induce the full complement of air, it is impossible to arrange that there be the same degree of air restriction and subsequent loss in the intensity of the flame. Fluctuations are greatly magnified in the actual results; for, as has been often pointed out, the luminosity of the mantle is proportional to some high power of its absolute temperature. Provided the flame shapes itself to the mantle, a small rise in the surface temperature of the flame means a great rise in the light emitted from the mantle.

I would seriously suggest that comparative tests made in the past, generally going to prove better results with the higher calorific gases, have been open to these objections, greatly to the detriment of the lower qualities. Personally, so far as I have been able to get at the facts, there is, I think, good ground for believing that, under more nearly parallel conditions, these results would be reversed. The importance of pressure cannot be overlooked; but it is something external to the quality of the gas itself. It is a physical condition, independent of composition, which enables the consumer to get from the gas its value to a greater or less degree. So long as the pressures of supply remain at the present low figures, the value of the gas to the incandescent lighting consumers must be relative to these pressures. The importance of pressure may be expressed in another way, by saying it secures the flame volume and the concentration of heat units within that volume. This practically is the same thing as temperature; for temperature is the measure of the intensity of heat—a point forgotten by many.

Now, a possibility is that the gases themselves, apart from flame volume, would secure to some extent the flame temperature. Theoretically, although the different gases composing coal gas have widely different calorific values, their temperatures of combustion lie pretty close together. Yet the small differences in practice might have important results:

	Calorific Value. Net. B.Th.U.		Temperature of Combustion. (Theoretical.) Deg. C.
Hydrogen	291	..	1960
Methane	976	..	1850
Carbon monoxide.	341	..	2100

Theory supposes instantaneous combustion without losses of any kind. In practice it is impossible to shut-off the flame from heat losses. Radiation plays a very important part; and for this reason also small flame volumes are necessary. In high-pressure lighting, we drive B.Th.U. past the burner-head at a rate which overtakes the radiation from the mantle. We have a smaller volume of flame for a given amount of gas consumed, and approach nearer and nearer to the maximum temperature that can be obtained without preheating the gas and air. The result in the luminosity of the mantle is wonderful—it is increased two or three times per volume of the gas consumed. The comparatively small increase in surface flame temperature brings about this result.

How far can the gases themselves secure a small flame volume? Have all gases the same flame volume when burnt under the same conditions? If they have, then the lower calorific gases ought to be better able to stand radiation losses, if properly consumed. For:

	B.Th.U. (Net).
Each volume of hydrogen with its proper amount of air =	116
,, ,, carbon monoxide ,, ,, ,, =	136
,, ,, methane ,, ,, ,, =	98

We know, however, that in consumption these volumes are not equal; and I suggest that the flame volume of hydrogen is far less than that of any other gas. Recently the "JOURNAL" published an extract from a German source to the effect that the flame volume of carbon monoxide was six times that of hydrogen, though these gases require the same amount of air in combustion. Whether the figure is right or not, a figure in this direction was to be expected. The presence of hydrogen in increased quantities would therefore tend to have just the same result as an increased pressure of supply; and generally I am of the opinion that in practice, provided the original pressure of supply was sufficient to inject the proper amount of air, the lower quality of gas would be of greater value to the lighting consumer. I cannot say what this adequate pressure would be—possibly up to 10 inches of water. It could easily be experimentally determined.

With this proved, the consideration would be whether the lower standard, which practically would be no standard at all—for it would be impossible with present plants to make gas of less than 475 B.Th.U.—would be worth while in view of a higher statutory minimum pressure. Each company with a knowledge of its system would have to decide this; and generally I should say it was. The introduction of water gas to any large amount is not looked upon with favour by Parliamentary Committees, and, as it introduces fresh problems, I do not at present propose to go into it. Parliament also seems to think that flat-flame burner users are still entitled to protection. If this idea is persisted in, it might be arranged, perhaps, with the aid of the chemist.

What, however, must be perfectly clear is the very small part that calorific value plays. It does not even secure a constant composition or a constant quality. It does not even make sure of the absence of incombustibles. If the lower calorific gases are in cases found to give the lower practical results, it is a matter of the accident of conditions. I take it that the industry wants all the freedom in supply that it can get. Let it undertake this investigation. At any rate there is nothing gained by remaining in ignorance. Even if flat-flame burner users have to be satisfied there is still room for considerable relief from restriction.

I have only dealt with lighting; but much could be said about heating and cooking, showing it cannot by any means be taken for granted that calorific value is of prime importance. At the outset, I said it was quite possible that the same supply was not best for all purposes. The efficiency in power uses would seem to be most likely of being affected by low qualities. I am not an engineer; but I believe it is the case that the efficiency of an engine on the Manchester supply is greater than on a London supply, even in proportion to the calorific value. I would suggest that this is not so much a matter of calorific value, but of the hydrogen content of the gas. In order that the combustion may be removed from explosive limits in compression within the engine, and brought under control for ignition by the usual devices, a greater excess of air in proportion has to be used with increasing proportions of hydrogen. Of course, any inquiry into the calorific question would not be complete unless it took into full consideration the effect of changes on the efficiency of the appliances at present in use by consumers.

EVENT AND COMMENT.

[COMMUNICATED.]

THE effect of the present war on the gas industry has been very fully dealt with in recent issues of the "JOURNAL." The consumption of gas for industrial purposes—particularly the smaller concerns—has been considerably curtailed; but it is to be hoped that things will resume a more normal state in the near future. The bye-product coke-oven industry has also been affected, but in a somewhat different way. At the commencement of the war, a number of iron and steel works suffered from an immediate cessation of orders, and there was a certain amount of slowing-down and consequent reduction of output. For several weeks prior to the declaration of war trade had been none too good, and a number of coke-oven plants had been at work considerably below their normal capacity. The consequence of the further decrease, due to the restricted demands of the furnaces, was that more ovens were put out of action, particularly those of the beehive type, while in some cases batteries were either closed-down completely or the outputs were reduced. The inevitable reaction of such a course is now being felt. There is a distinct scarcity of furnace coke, and prices are rising accordingly. From this point of view, the outlook for bye-product coking people is becoming very favourable.

THE DISPOSAL OF RESIDUALS.

DIFFICULTIES are being experienced both on gas-works and coke-oven plants with regard to the disposal of residuals. The writer is informed on good authority that ammoniacal liquor is difficult to dispose of; the usual buyers having been compelled, through force of circumstances, to stop the manufacture of their various products. Consequently they have not had sufficient storage room to accommodate the bulk of liquor offered. Those who make sulphate at their own works are placed in a rather more favourable position. Even then, sulphate is not selling well just now. But it is not a difficult matter to store it in large quantities; the principal objection being, however, that a large amount of money soon becomes locked up in the form of stocks. The disposal of tar, too, has not been unattended with difficulty. Again, lack of storage accommodation has been an important factor; the large distillers having had to restrict their operations owing partly to the embargo placed upon the export of creosote, and partly to the fact that the demand for pitch has been below normal. As far as benzol is concerned, the writer has not heard of any difficulty. The increasing use of this product for use as motor spirit has created a good market; and this is particularly noticeable as soon as there is any talk of a petrol famine, or even of a substantial rise in price.

"CAPTURE GERMAN TRADE."

THIS has been quite a war cry of the daily press just lately, and lay journalists have discoursed very freely upon technical matters which they do not understand, in a way which would be merely amusing were it not so ridiculous. The enormous amount of organization put forward by the Germans in developing their great chemical industries seems to have been left out of account altogether. It is little short of absurd to imagine that such an industry as that of the manufacture of aniline dyes can be transplanted to this country by a few strokes of the pen of an enthusiastic patriot. To begin with, an enormous amount of capital is required; expensive plant and machinery are required; and these, together with the fact that many of the processes of manufacture are secret and known only to comparatively few persons, render the transference at least one of great difficulty. Indeed, such a transference would take years to carry out. By all means, let our manufacturers make a start to bring back to this country these valuable industries; but do not let us deliberately mislead ourselves as to the nature and enormity of the tasks we are about to attempt. The same reasoning applies to most of the finer chemical

industries, such as the manufacture of pure chemicals for scientific work, the manufacture of artificial scents, fruit essences, &c. These industries have been created as a result of a vast amount of scientific thought and research by some of the best brains of the German Empire; and only by an expenditure of an equal amount of energy and skill—not to mention the monetary side of the matter—can we hope ever to attain anything at all in these matters. If we are to make the attempt (and by all means, we should do so), the effort which will have to be made can, in the writer's opinion, only hope to succeed if it is subsidized by the Government, thereby taking the first step towards the liberal recognition by the State of scientific research in the interests of industry. But there are other fields of industry in which we can capture German trade, and at once; and it is towards these that attention might be directed immediately. These are the numerous cases in which British and German firms come into open competion in the Home and Colonial markets. We can in these industries gain much by emulating the Germans in giving more prominence to the scientific side of them, and in encouraging that original research which ultimately leads to true progress.

Bye-Product Recovery.

The development of various systems of carbonization, both in connection with gas making and the manufacture of metallurgical coke, has not involved any vital change in principle of late years, but has been confined to the attaining of higher efficiency in the way of an increased yield of gas, a decreased fuel consumption, and the introduction of labour-saving devices at all points. It is, therefore, rather in connection with the chemical side of the industry that we must look for the bulk of future development. In other words, we must expect an extension of the scope of bye-product recovery and an increase in the number of chemical operations on the plant. There is an undoubted tendency in connection with coke-oven plants for each concern to distil its own tar. Several of the products are easily disposed of. Creosote can usually be made use of at the plant for the purpose of benzol recovery; the light oils go in with the crude benzol; the pitch can often be disposed of locally; and there is almost always a certain and satisfactory market for other products. In some instances, the manufacture of disinfectants is receiving attention. Indeed, the possibilities of a tar-distillation plant are very numerous, and quite a number of the larger coke-oven proprietors are at the present time erecting plant of this type. Further, the utilization of coke-oven gas for gas-engines is on the increase; and this necessitates the purification of the gas from sulphur compounds. This, in turn, opens up another possibility, which in itself is a distinct step towards that ideal of self-contained bye-product recovery—viz., the utilization of the sulphur in the coal for the manufacture of sulphate of ammonia. The sulphur can be recovered in the usual gas-works method by means of oxide of iron, and the spent oxide ultimately employed to provide the sulphur dioxide to be used in the manufacture of sulphuric acid.

THE CREOSOTING OF TIMBER.

A recent issue of the "Journal of the Society of Chemical Industry" contained abstracts from several sources of articles dealing with this question.

Two extracts are made from the "Transactions" of the American Wood Preservers' Association for the current year. The first was from a paper by Mr. G. Alleman, on "The Quantity and Character of Creosote in Well-Preserved Timber." The author stated that the creosote oils extracted from timber which had been in use many years showed an average of 32·9 per cent. of distillate below 270° C. and 66·8 per cent. of oils of high boiling point. The defects of most modern creosote preservatives are deficiency in basic oils of high boiling point, and the substitution for these of tar or other viscous substances. Under proper conditions of distillation a stable and heavy creosote oil (sp. gr. 1·10) could be manufactured from coal tar, containing nothing which boils below 210° C. For general purposes not more than 50 per cent. of the total should distil below 315° C.; and for wood-paving blocks not more than 35 per cent. The qualities demanded are penetrating power, stability, and preservative and water-proofing value. All these are possessed in a high degree by pure, heavy creosote oil. Tar has a very low penetrating power, even when injected at a high temperature, and wood treated with a mixture shows a separation of the components, oil, tar, and carbon, at the margins of the close-grain rings. As regards stability, losses occur owing to volatilization, extraction by water, and crystallization in wood impregnated with light creosote oils.

Dealing in the same "Transactions" with "The Use of Refined Coal Tar in the Creosoting Industry," Messrs. H. von Schrenk and A. L. Kammerer pointed out that the efficiency and permanence of the preservative effect of creosote oils depend on the proportion of oils boiling above 235° C., and this corresponds inversely with the rate of evaporation in open dishes or in timber test-blocks. The best results are always obtained with a heavy oil, equivalent to the No. 1 specification of the American Railway Engineering Association; but the supply of such oils is limited and far short of the demand. The blending of a small proportion of refined coal tar enables inferior oils to be used with more satisfactory results, as regards permanence, than are obtained with such oils in the pure state. The inferior creosote oil should be thoroughly mixed in the proportion of 80 parts with 20 parts of coke-oven coal tar, containing not more than 5 to 6 per cent. of carbon, at 180° Fahr. (83° C.); and the temperature of the mixture during impregnation should not be below this. The penetrating power of the mixture is not less than that of creosote oil if the time under pressure be slightly increased.

Dealing with the wood preserving industry in the United States, the "Board of Trade Journal" for July mentioned that returns from 93 wood-preserving plants, of which 58 are commercial plants and 35 private plants (of these 26 are operated by railway companies), show that last year these plants treated 153,613,888 cubic feet of material, or 21·9 per cent. more than in 1912. The total consumption of creosote oil by these plants in 1913 was 108,373,359 (American) gallons—an increase of 29·5 per cent. over the previous year. The consumption of zinc chloride amounted to 26,466,803 lbs.—an increase of 27·5 per cent.; while of miscellaneous liquid preservatives the total used was 3,885,738 gallons—an increase of 26·4 per cent. The quantity of creosote imported in 1913 was 62 per cent. of the total amount used. New plants for the manufacture of creosote oil are, however, being erected in the middle west; and, if present plans materialize, they should add about 10 million gallons annually to the available supply of creosote.

RUST PREVENTION OF IRON AND STEEL.

Value of a Zinc Coating.

In "L'Electricien" for the 25th of July last there appeared a translation, from the "Zeitschrift für Feinmechanik," of some remarks explaining why a thin coat of zinc is the best protection against rust for iron and steel. It was pointed out that when these materials are exposed to the influence of the air, a slight galvanic action is produced, consequent upon the fact that when two different metals are in contact in presence of atmospheric humidity they always form a galvanic element, and slow decomposition occurs on the electro-positive element. As the electric current produced by the galvanic element is naturally very slight, its action as regards decomposition of the electro-positive metal is also slight. If iron or steel coated with zinc is exposed to the air, decomposition occurs and attacks the zinc, which constitutes the electro-positive substance in relation to iron. Decomposition takes place exclusively on the zinc, while the iron remains intact, supposing zinc still exists on the iron. This action is always going on, whether the coating of zinc be thick or thin. The only advantage of a thick coat is that it will last longer. In ordinary atmospheric conditions, however, when a very small percentage of moisture is the only cause of the production of the electric current, the galvanic reaction is very slight, and a coating of zinc will last a long time. In presence of sea water or air containing saline humidity, decomposition is naturally much quicker, and then only is a thick coating of zinc necessary. Protection of iron or steel by zinc against rust is therefore ascribable to the fact that the zinc is decomposed, through a galvanic action, at the expense of the metal it covers. If there were no decomposition, zinc could not be utilized for the prevention of rust. The decomposition of zinc is very slow and superficial, which is a point of great importance.

United States Mineral Oil Exports.

The "Journal of the Society of Chemical Industry" extracts from the Aug. 3 number of the "Oil, Paint, and Drug Reporter" the following particulars of exports of mineral oils from the principal customs districts of the United States (representing about 98 per cent. of the shipments from all parts) during the twelve months, July 1, 1913, to June 30, 1914:—

—	Gallons.	Value.
Crude oil	146,056,086	$6,808,513
Illuminating oil	1,155,809,430	74,374,091
Lubricating and paraffin oils	195,472,181	27,566,378
Naphthas, gasoline, &c.	185,578,776	26,568,682
Residuum, gas oil, fuel oil, &c.	586,301,600	15,562,192
Total, 1913-14	2,269,218,073	$150,879,856
,, 1912-13	1,947,746,303	134,514,109

Testing Motor-Cars (when Building) with Town Gas.—According to the "Scientific American," in consequence of the cost of gasoline being comparatively high, and by way of reducing factory outlay, a number of Detroit makers have taken to testing their motors with town gas instead of with gasoline. It is found that an economy of as much as $80 a day can be effected by some makers. Town gas at 45 c. per 1000 cubic feet is said to be cheaper for the purpose than gasoline at 9 c. a gallon. A comparison of costs reveals that an engine developing 19·04 horse-power consumes 458 cubic feet of gas, which costs 20·61 c. an hour; while 2·24 gallons of gasoline would be required to develop the same power, and the cost would be 33·6 c. an hour with gasoline costing 15 c. a gallon. On one test, it was proved that the cost of town gas works out at 58 per cent. of the cost of gasoline.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.

ANNUAL MEETING IN GLASGOW, THURSDAY, SEPTEMBER 3.

PRESIDENT: DAVID VASS, of Perth.

The Fifty-Third Annual Meeting of the North British Association of Gas Managers was held last Thursday in the Rooms of the Institution of Engineers and Shipbuilders in Scotland, Elmbank Street, Glasgow—the attendance numbering about eighty. Mr. David Vass, the Gas Engineer to the City of Perth, the President of the Association, occupied the chair.

Introductory.

The President said that the circumstances under which they were met that morning were somewhat unusual. They were carrying on business as usual in a kind of way, but it was business and nothing else which would comprise the programme for the day.

Report of the Committee.

The President remarked that the report of the Committee [*ante*, p. 447] had been in the hands of the members for some time; and it gave a very satisfactory statement in regard to the position of the membership and the way the work generally had been carried on. He would, however, emphasize the part of the report in connection with the Commercial Sections. So far, the number of members who were taking advantage of the Commercial Sections was small in proportion to the total membership of the Association. Unfortunately, the East of Scotland district was so large that they had to move their meetings from place to place; but the members who felt themselves a little bit isolated by this arrangement, would surely find one meeting in the course of the year at which their presence would be helpful and convenient to themselves. It was well to bear in mind that the Commercial Sections had not been started purely for the purpose of keeping up the price of coke. As they would see, many other items of business were discussed at these meetings; and he hoped the members generally would endeavour to support the Commercial Sections in their various districts. He might mention that they had a new section in connection with the Waverley district. While this section was not directly connected with the North British Association, they welcomed it as an addition to their own Commercial Sections, and he was glad to say it was doing good work in its own particular district. Proceeding, the President went on to note that the Benevolent Fund was in a very healthy condition, and when called upon had been found to be of some service to one or two of their more unfortunate colleagues. They were at the annual meeting that day to be favoured with another lecture under the "William Young Memorial Trust;" and, in this connection, he might observe that the scheme was proving its usefulness in a very marked degree. Indeed at the moment there was every appearance that they might be able to have a lecture annually under the auspices of the Trust—at all events, they anticipated being in a position to do so for some years to come. Personally, he had not the slightest doubt but that the lectures would add very materially to the usefulness and helpfulness of the annual meetings. During the past year the Association had had a change of Secretary. Mr. Laurence Hislop, F.C.S., of Uddingston, had retired from the position, and Mr. Peter B. Watson, of Wishaw, had been elected by the Committee in his stead. Mr. Watson, as many of the members knew, had had experience as Secretary of the Commercial Section at the Glasgow meetings; and this had kept him well in touch with gas matters for a number of years. Mr. Watson, therefore, in taking up the larger duties connected with the Association, would be fortified by his past experience.

The Secretary and Treasurer (Mr. Peter B. Watson, of Wishaw) formally submitted the annual report of the Committee, together with the accounts for the year ended June 30.

On the motion of Mr. James M'Leod, of Greenock, seconded by Mr. J. B. Scott, of Cowdenbeath, the report and accounts were adopted.

Grant to the War Relief Fund.

The President said that the next business they had to consider was one which had been brought before them owing to the special circumstances under which they were meeting that day. Many of them could not, as individuals, do much in the way of personal service for their country at this time; but they as an Association might do something in a financial way. No doubt every one of them as individuals was performing his own personal service in the national crisis; but the Committee felt it was a pity that a sum of £90 should be lying idle, so to speak, in the bank, when it might be doing great work for the country at the present juncture. The Committee did not propose that the whole balance of £90 should be devoted to the War Fund; but they strongly felt that a portion of the money could safely be voted for national purposes on an occasion like the present. The Committee knew that the proposal was outside the scope of the Association's work; but when the rules were drawn up, no one dreamt of this European War, or he was confident a clause would have been inserted to get over any difficulty. The proposal he had to put before the meeting was that they should vote a sum of £50 towards the National Relief Fund; and while he put forward this motion he was quite well aware that its terms were outside the scope and objects of their funds as an Association. At the same time, he hoped the motion would be carried unanimously, because unless this was so the Association would not be in a position to make any grant at all.

Mr. J. B. Scott (Cowdenbeath) said he had great pleasure in seconding the proposal which the President had made. Personally, he did not think there was a single member of the Association who would say a word against it. No doubt, as the President had said, the motion was rather against their rules, but at the same time they had to remember that "all is fair in love and war." He thought they should allow the rules to go to the wind in an emergency such as the present. The money, he was confident, would be very acceptable, and would do far more good than merely lying dormant in the bank.

The recommendation of the Committee was cordially agreed to.

Apologies for Absence.

The President remarked that he had omitted earlier to intimate a number of apologies for absence which had been received. In the list he had before him he found the names of several gentlemen resident in the south. As they could well understand, there were great difficulties connected with railway travelling at this exceptional period, and this circumstance accounted in a great measure for the absence of those who had to come from any distance.

President's Address.

The President then delivered the following

INAUGURAL ADDRESS.

I have to thank you for the compliment you paid to me in accepting the invitation of the Perth Town Council to hold your annual meeting in Perth during my term of office. It is a matter of regret to us all that events during the past month have caused an alteration in our plans; but I trust that your visit to Perth is only postponed, and that we may have the pleasure of welcoming you there in the near future.

In the early history of Scotland, Perth held a very prominent place; so that it is not surprising to find it early in the field in the matter of adopting the "New Illuminant" as gas was termed at the beginning of the second quarter of last century.

PERTH'S FIRST GAS-WORKS.

The first Company for the supply of gas to the City of Perth was formed in 1824; and the works were designed and erected by Mr. Adam Anderson, LL.D., Rector of Perth Academy, and subsequently Professor of Natural Philosophy in the University of St. Andrews. He was also the designer of the water-works; the classic design of the pumping-station erected by him being still a prominent feature by the river at the foot of Marshall Place.

The first retort-bench and retort-house were unique in design; being in the form of a semi-circle, with mouthpieces radiating to a common centre. One can hardly realize what could have been the intention of such a form unless it was that the designer had visions of operating the retorts by mechanical means working from a fixed centre. The condensers were four cylindrical vessels, about 8 feet high and 6 feet diameter, stuffed with twigs of heather and broom, in which the tar was intercepted by the twigs and found its way to a tar pit. The purifiers were small, about 6 feet long and 4 feet wide. The two gasholders, having a joint capacity of 10,000 to 12,000 cubic feet, were enclosed with a substantial stone building measuring 90 feet long by 50 feet broad.

The works were in their early days considered to be a model in design and efficiency, and, we are informed, were often visited by parties about to construct works for other towns.

The price of gas in 1827-28 was 12s. 6d. per 1000 cubic feet; but as the gas-meter in use at that date was a very costly article, many of the consumers were supplied on the contract system, which was continued till 1844.

In those early days the disposal of the liquid bye-products was a difficulty; and it was resolved that the tar should be used as an auxiliary to the fuel employed in heating the retorts—the surplus being burned in a chamber constructed for the purpose, and the smoky products discharged by means of a tall chimney.

In the winter of 1828-29 it was found that coal tar as a fuel produced a very fierce heat; and the cast-iron retorts exposed to it, although shielded by fire-brick protectors, were very quickly injured by the penetrating heat. Various consultations ensued between Mr. Reid, the Gas Manager, and Mr. M'Vicar, a fire-brick maker at Inverkeithing, as to whether retorts could be made entirely of fire-clay; and the result was a trial of two or three retorts made in short lengths and jointed together with fire-clay. They were found to be gas-tight; and gradually fire-clay retorts superseded cast-iron ones at the Perth works even at that early date.

In 1844 a rival Company came on the scene. They erected

their works alongside the Town Lade, near the "Fair Maid's House," on ground that is now part of Messrs. Pullars' Dye-Works. Serious competition between the Companies for the business followed, with results that were not beneficial to either Company; and in 1868 an amalgamation was effected between the two concerns. The manufacturing power of the old Company was then about 29 million cubic feet per annum, and of the new Company about 11 millions per annum. The price of gas after the union was 6s. 8d. per 1000 cubic feet.

Mr. Thomas Whimster—a gentleman who took a very active part in our Association in his day, and who was appointed Manager of the old Company in 1851—became Manager of the combined Companies. The works were under his management when the transfer to the Local Authority took place in 1871; and he continued in the active service of the Gas Commissioners until 1895, when he retired from the position of Manager, having occupied this post for 44 years. At the date of transfer to the Corporation the sale of gas was 32½ million cubic feet, and the price was 5s. 10d. per 1000 cubic feet.

The combined capital of the two Companies now amounted to £45,000; and the transfer was effected on a basis of 6¼ per cent. perpetual annuities, amounting to £2812 10s. per annum. This, on an annual output of 32½ million cubic feet, is equal to 1s. 8¾d. per 1000 cubic feet of gas sold, exclusive of sinking fund and contingency fund. The value of these annuities at that period may be taken as about £156 per £100 stock; so that the price was equivalent to a market value of £70,240, or £2161 per million sold, or, taken on the working capacity of the combined works (40 millions), equal to £1756 per million.

It will be noticed that I have taken the price of the £100 stock at £156—its market value in 1871; but when the Corporation began to purchase back the annuities some 24 years later, the market value was very much increased, and the average price of those purchased to date has been about £200. Assuming that the balance of the annuities can be redeemed at the same figure, the cost of acquiring the works of 40 millions capacity will work out at £2250 per million cubic feet, or taken on the sales at £2770 per million, which undoubtedly ranks among the highest prices, if not actually the highest price, paid for a gas undertaking. Further, the amount to be set aside for sinking fund was only sufficient to make up the purchase price in something over 56 years. Thus when we compare this transfer with those of more recent date, averaging about £1000 per million cubic feet of gas sold, and requiring not more than 1s. per 1000 cubic feet for interest and sinking fund, it is not surprising to find that the heavy capital charges of that time (43 years ago) still have their effect on the finances of the undertaking.

The original capital burden was added to, first, by an expenditure of £11,712 in extending the Canal Street works, and abandoning the Blackfriars works—all within three years after the purchase—and again in 1901, when the present works at Friarton were erected at a cost of £58,000.

Table No. I. shows the position of capital account and the annual charges for interest and sinking fund at (A) date of closing of Blackfriars works, (B) date of closing of Canal Street works, and (C) present time.

There has been for the past six years an additional annual charge for contingency fund and depreciation equal to 1½d. per 1000 cubic feet.

The policy of the department, during the past decade, of increasing the output by increasing the sales per consumer as well as extending the number of consumers has resulted in an increased sale during the past fourteen years of 75,000,000 cubic feet, at a capital expenditure of £20,000 on distribution, equal to £266 per million, and a like sum in extensions of manufacturing plant.

The wisdom of the expenditure of £6260 from the reserve fund on plant for handling residuals and for the economic working of gas manufacture is shown by comparing the figures given in Table No. II.

TABLE No. II.

—	Manufacturing Charges.	Revenue from Residuals.	Net Cost into Holder.
	s. d.	d.	s. d.
1901-02	2 2·288	4·967	1 9·321
1913-14	1 11·804	11·472	1 0·332
Decrease. . .	2·484	..	8·989
Increase . . .	..	6·505	..

PRESENT-DAY ASSESSMENT.

Incidentally I would voice the general opinion of administrators of gas undertakings, and particularly those of corporation undertakings, that the present system of arriving at the assessable value is very unfair, in that it practically depends on the amount which must necessarily be raised to meet interest and sinking fund—the greater the amount required for such funds the greater assessable value, whereas it will quite easily be seen that the capital value has only a remote relation to the business done or the area of ground covered by the undertaking. Undertakings having heavy capital burdens to bear—*i.e.*, heavy in proportion to business done—should find relief in rental charges or their equivalent.

In other commercial undertakings where there are financial burdens on the one hand or exceptional advantages on the other, the rental, and consequently the assessable, value of the concern is modified accordingly. Yet while an engineering or other industrial concern occupying an equal area to the gas-works may have ten times the turn-over, and perhaps a corresponding ratio of profits, the assessable value of such a concern will be found to be far below that of the gas undertaking.

It is time that gas undertakings put forward a plea to be assessed on a commercial basis which would bring them in line with other manufacturing industries, by taking (say) the structural value of the works, or some such means as would make the assessable value of any two gas-works of similar ground area and annual output, considering geographical situation, approximately equal, instead of varying as they do at present to the extent of over 50 per cent. in many cases.

FRIARTON WORKS.

The retort-bench erected at the Friarton works in 1900 consisted of a back-to-back bench of 14 ovens, with settings of eight single retorts to the oven. With the class of coal then in use—*i.e.*, cannel and screened splint—the bench was equal to 900,000 cubic feet of gas per twenty-four hours. Since then the bench has been altered to "through" settings of nines, giving an increase of about 20 per cent. in carbonizing area. With the change from screened coal to washed nuts, the producing capacity of the bench is now 1,000,000 cubic feet per twenty-four hours. An additional bench of seven ovens of "throughs"—four set with nine and three with eight—has also been erected, having a producing capacity of 950,000 cubic feet per twenty-four hours.

The retort-house has a coal-store, on one side of it, running the full length of the house, divided only from the retort-house by pillars, and has a high-level railway; the rails being 15 feet above the ground level.

The retort-house was fitted with West's manual stoking machinery, one set on each side of the house; the coal being conveyed by means of a steam-driven chain-bucket elevator and conveyor-belt to stationary storage hoppers. The West machines were duplicated in 1903, and at the same time the coal elevating plant was supplemented by the erection of a hydraulic hoist.

TABLE No. I.

Date.	Gas Sold. Cubic Feet.	Loan Capital.					Interest, &c.		Sinking Fund.		
		Total Issued.	Repaid.	Out-standing.	Per Million Sold.		Total Annual Payment.	Per 1000 Cubic Feet Sold.	Total Annual Payment.	Per 1000 Cubic Feet Sold.	Total.
					Issued.	Out-standing.					
(A) 1873-4	34,395,000	£11,712 90,000*	*Nil*	£101,712	£340 2617	£2957	£413 5 2 2812 10 0	22·51	£500	3·49	26·00
		£101,712			£2957		£3225 15 2				
(B) 1901-2	181,099,000	£125,977 90,000*	£21,300 5,150	£104,677 84,850	£1193	£1046	£3170 18 2 2624 12 7	7·68	£1750	2·32	10·00
		£215,977	£26,450	£189,527			£5795 10 9				
(C) 1913-14	256,200,000	£167,431 90,000*	£49,380 34,978	£118,051 55,022	£1005	£676	£4214 9 4 1808 5 8	5·64	£5129 1004	5·74	11·38
		£257,431	£84,358	£173,073			£6022 15 0		£6133		

* Annuities valued at £200.

Two years ago the West machines were displaced by the introduction of a De Brouwer combined charging and discharging machine, operated by electricity; new coal storage hoppers being erected the full length of the retort-house on the one side, and the existing coal-elevator lengthened to feed on to a new set of tip-tray conveyors running the full length of the coal storage hoppers.

A 42 H.P. gas-engine, direct coupled to a 23 K.W. dynamo, was erected to generate the current required to work the stoking machine and the tip-tray conveyor, and for a coke hoist and railway capstans. At the same time it was arranged to take a connection from the Corporation electric mains, and, owing to the length of main, a guaranteed minimum of electric consumption was required. In practice it is found that the total current required per annum barely reaches the minimum guarantee; so that our own gas-engine supply is now retained as a stand-by in case of any defect in the Corporation current.

Owing to various causes—chiefly the inexperience of our men—we had several breakdowns of the electric plant connected with the De Brouwer machines, and were driven back to the use of the West machines to keep up the supply. We found it an extremely difficult matter to draw by hand the retorts which had been charged by the machine; and again when the machine was ready for action the discharging by machine of hand charges gave some trouble. In consequence of this, we decided to get a spare De Brouwer pusher—this being the part which gave most trouble. Since then we have had very little trouble, and have not had occasion to resort even once to the West machines, nor to hand drawing. There is no doubt, however, that it is necessary to give special attention to the selection of the coal, as anything in the nature of a dry, non-caking material will give trouble. Some nuts, which when fresh from the pit will work satisfactorily, are found to entirely lose their caking property after lying in stock, and the ram has great difficulty in pushing them through. Our comparative cost of working the De Brouwer as against the West manual machine is as follows :—

TABLE No. III.—*Carbonizing Costs with West's Manual Stokers, as Compared with the De Brouwer Electric Stoker.*

WEST'S MACHINES.

Maximum week ending Dec. 20, 1911.

Gas made, 6,807,000 cubic feet.

	£	s.	d.
18 Machinemen	29	19	4
3 Boiler and exhauster attendants	5	2	8
8 Hot-coke wheelers	10	17	7
2 Producer attendants	3	0	8
3 Coal attendants	4	11	0
1 Retort scurfer	1	7	8
Proportion of foreman's wages	1	4	7
	£56	3	6

Per 1000 cubic feet of gas made, 1·98d.

DE BROUWER MACHINE.

Maximum week ending Dec. 31, 1913.

Gas made, 6,967,000 cubic feet.

	£	s.	d.
12 Machinemen	20	18	0
3 Boiler and exhauster attendants	5	2	8
6 Hot-coke wheelers	8	6	0
2 Producer attendants	3	10	6
2 Coal attendants	3	13	2
1 Retort scurfer	1	9	10
Proportion of foreman's wages	1	5	0
	£44	5	2

Per 1000 cubic feet of gas made, 1·52d.

WEST'S MACHINES.

Minimum week ending July 19, 1911.

Gas made, 2,667,000 cubic feet.

	£	s.	d.
9 Machinemen	15	10	8
3 Boiler and exhauster attendants	5	2	8
3 Hot-coke wheelers	4	8	0
2 Producer attendants	3	0	8
2 Coal attendants	2	16	4
1 Retort scurfer	1	6	7
Proportion of foreman's wages	1	4	7
	£33	9	6

Per 1000 cubic feet of gas made, 3·01d.

DE BROUWER MACHINE.

Minimum week ending July 8, 1914.

Gas made, 3,000,000 cubic feet.

	£	s.	d.
9 Machinemen	16	12	8
3 Boiler and exhauster attendants	5	6	4
3 Hot-coke wheelers	5	0	10
1 Producer attendant	1	15	0
2 Coal attendants	3	13	2
1 Retort scurfer	1	9	10
Proportion of foreman's wages	1	5	0
	*£35	2	10

Per 1000 cubic feet of gas made, 2·81d.

* Includes increases granted to workmen amounting to 9 per cent.

It is anticipated that the saving will be increased as we gain more experience in working the plant.

In 1902 plant was erected for elevating and screening the coke. It consisted of a hydraulic hoist for raising the coke in side-tipping waggons to a height of 30 feet above the level of the railway. At this height it is tipped on to a shaker-screen with two sizes of perforations, and divided into breeze, coke nuts, and screened coke respectively. The three loading hoppers into which the material drops are each capable of holding 10 tons, and by the drawing of a lever the coke is discharged from the hoppers direct into the railway waggons or into carts. There is also a gangway leading away from the hoist at a height of 10 feet, for storing coke in the yard when the output exceeds the orders on hand.

The speed of travel of the hydraulic hoist was found to be rather slow for midwinter service, and an electric hoist was then substituted. The first starting switch used in this work gave frequent trouble by over-heating, especially when working the short journey—*i.e.*, when stocking—but an improved type of starting switch has been erected, and greater freedom in working is expected. The original starting switch is retained as a stand-by; and my experience with electric plant generally is that duplicate parts are very essential.

TAR STILLS.

Plant for the distillation of tar is erected on the highest level of the works at Friarton. It consists of two stills, each capable of dealing with 800 gallons of tar at each run. One furnace heated by coke on the generative principle is used for the two stills. There is a heavy demand for refined tar from the beginning of May to the end of August; while the demand for the winter months is very limited. To assist in increasing the output of our stills we erected a large tank capable of holding 1500 gallons; and here we preheat the tar before running into the stills. By this means we have increased the working output by 50 per cent., as the tar can now be run into the still very soon after the still has been run off, which was not the case when filling cold tar direct into the still.

During the winter months it has usually been found necessary to carry the distillation right on to pitch; there being an insufficient outlet for refined tar at this season. The make of crude tar being at its heaviest, steps have to be taken to prevent overflowing of the tar wells; but as a rule it does not pay a gas-works to go on to pitch, unless they have a large plant to enable them to make the most of the heavy oils.

Our working cost for manufacture, exclusive of standing charges, for the past year are shown in Table No. IV.

TABLE No. IV.—*Working Expenses, Tar Distillation Plant.*

Year ending May 15, 1914.

Tar distilled, 214,734 gallons.

	£	s.	d.		Per Gallon of Tar Distilled. d.
Wages	218	8	9	..	0·244
Coke used	68	0	0	..	0·076
Repairs and sundries	39	0	0	..	0·044
	£325	8	9	..	0·364

AMMONIA PLANT.

Placed as we are at Perth, in an agricultural centre, we have no difficulty in disposing of all our sulphate of ammonia locally; but in order to make the best out of it, we require to have large stores sufficient to hold up our total make until it is required. All our sales take place in the spring time—usually in January and in March of each year; and deliveries are mainly confined to the two months from the middle of March to the middle of May.

Our working costs for the manufacture of sulphate of ammonia may be of interest. They do not include charges for ground rent, interest on plant, nor for sinking fund.

TABLE No. V.—*Working Expenses on Sulphate of Ammonia Plant. Year ending May 15, 1914. Amount produced, 250 tons.*

		£	s.	d.		Per Ton of Sulphate Made. s.	d.
1.	Fuel (say, one-tenth of fuel used on works boilers)	67	0	0	..	5	4·32
2.	Lime	20	19	11	..	1	8·16
3.	Acid	401	7	10	..	32	1·34
4.	Wages	191	18	10	..	15	4·26
5.	Registration	3	0	0	..	0	2·88
6.	Repairs	62	10	0	..	5	0·00
7.	Sundries, including subscription to Sulphate of Ammonia Association	12	9	4	..	0	11·96
		£759	5	11	..	60	8·92

The recent heavy fall in price of sulphate, attributed in a great measure to the extension of the synthetic process, has given rise to grave anxiety on the part of sulphate makers; and the effort to stem the downward tendency is worthy of our earnest support. Indeed, a drop of 10 per cent. on last year's price of sulphate and the heavy slump in coke sales is in many cases far outbalancing the reduced price of coal; and it says a great deal for the stability of our industry that in many cases the steady increase in gas sales has been sufficient to meet the strain.

The question of obtaining increased yields of ammonia per ton of coal carbonized has been receiving special attention during the past year. The paper read by Mr. Purves before the meeting of the Institution of Gas Engineers in June has shown that increased yields under certain conditions are possible; and the lecture by

Professor Cobb to the North of England Association indicates that temperature conditions play a great part in the production of ammonia. During the progress of coal distillation it lies with us to determine if in our practice we can focus these points so as to obtain all, or nearly all, the nitrogen that is in the coal in a useful form as ammonia, instead of passing off with the coke.

I have recently been making tests to arrive at the average quantity of ammonia present in the crude gas at different periods of the charge under ordinary manufacturing conditions; and these I purpose to follow up by tests under varied conditions. I find that this is work which takes time; but if several minds interested in the subject and working in harmony could consult and compare, much good work would be done, and the time occupied by the individual in preliminary experiments greatly reduced.

GASHOLDER STATION.

The gasholder station is situated at the south-east corner of the South Inch, and comprises two gasholders and a governor-house with three district governors. There is also a small boosting plant for giving normal pressure to the village of Bridge-of-Earn, which is about four miles distant, and is about the same level as Perth, but lies on the other side of Moncreiffe Hill. A 6-inch gas-main is led from the holder station up the hill, where it reaches an elevation of 200 feet above the gasholder station, and then down a long slope of fully two miles into the village. The booster is of the Westinghouse type, driven by belt from a Westinghouse steam-engine; and a pressure of 8 inches at the holder station is sufficient to give an average pressure of 3·5 inches in the centre of the village. The booster is only put on at dusk and stopped-down at 11.30 p.m. In winter it is on from 5.30 a.m. till daybreak. The holder pressure is found to be sufficient for the day load.

No. 1 holder, erected in 1888, was designed by my late chief, Mr. Samuel Stewart, of Greenock. It is a two-lift telescope holder of the twin-column type, with counterbalance weights set between each pair of columns, similar to those at Inchgreen. The capacity is 550,000 cubic feet. The other holder, a Gadd and Mason rope-guided two-lift one, which is of the same capacity, was erected in 1896, as was also the governor-house and district governors. One governor is placed on the main leading to the higher parts of the town—*i.e.*, the Craigie district; a second is for the portion of the town on the north side of the River Tay—the Bridgend and Scone districts; while a third is on the city. Bridge-of-Earn, as already mentioned, is supplied through a special main, and does not meantime require a station governor.

WORKSHOPS AND SHOW-ROOMS.

The show-rooms and workshops are still retained in the town, on part of the site of the old gas-works. The show-room, though near the centre of the town, is in a quiet side street, and does not give the best opportunity for a display. By an arrangement with the gas-fitting trade in the town, we act as a wholesale house, buying-in gas-pendants, brackets, lamps, gas-burners, mantles, &c.—confining ourselves to the better grade of goods. In this way we save the tradesmen the necessity of holding stocks; they sending their customers to our show-rooms in the same way that many around Glasgow send their customers to the wholesale houses there. This system has its advantages and also its disadvantages; and I could not recommend it to any gas undertaking situated near a populous centre, such as in the vicinity of Glasgow or Edinburgh. For such places I have no hesitation in advocating direct sale to the public, who are, after all, our customers already in our main commodity, gas, and also in coke. Therefore why draw the line short of gas-fitting and gas-burners and accessories?

Adjoining the show-rooms are our workshops. In addition to the usual staff of gas-fitters, we carry out our own meter repairs, and have the meters stamped by the local inspector. Under the same roof we have also a stove-cleaning plant as well as a plant for re-tinning.

STOVE CLEANING PLANT.

In the early days of the single-lined cooker quite a large number of these found their way to Perth, and no doubt did good work in introducing the cooker to a class of consumer who had till that time been difficult to secure. After the lapse of a year or two, however, there arose a strong demand for exchanges to the double-lined cooker; and in this way a great number of single-lined cookers were thrown into stock. To get these out again, it became necessary to have them overhauled, lined, and packed; and this was done by sending the cookers back to the makers. The cost of carriage, &c., proved excessive, however, and it was decided to do the work in our own workshops. After experiment, the present plant was erected, consisting of two baths for strong soda, and a drying chamber with sliding door; the whole being heated by a slow-combustion coke furnace. The furnace is damped-down overnight, and this keeps up a gentle heat on the baths and prevents trouble by fracture which was experienced in our early experiments.

All cookers, packed and unpacked, are taken to pieces (excepting cookers that are only slightly used), and the parts, including burners, placed in a strong caustic soda bath, where they remain for from one to three hours. On being taken out of the bath they are scrubbed clean, washed in cold water, and dried in the hot chamber. The stoves are then rebuilt, including relining and careful padding, and finished off by painting with a good air-drying black stove enamel; the brass work is cleaned and polished with a steel brush; and the cornice and other relief parts are polished on an emery wheel and buffed. The finished stove looks as good as new. This is a great improvement on the old style of cleaning by rubbing over with a soda preparation and washing off. All appliances are later on tested as to burner adjustment, and "returns faulty" are unknown.

STOVE CLEANING COSTS.

The cost of cleaning cookers and hot-plates can be seen by the following data:—

TABLE No. VI.—*Cooker Cleaning.*

Time on four No. 2 Main Cookers.

	Hours.	Rate. d.	Value. s. d.	Average. s. d.
Stripping and unpacking	6	6	3 0	0 9
Cleaning and drying	9	6	4 6	1 1½
Buffing and repairing	4	7½	2 5	0 7½
Rebuilding and packing	6	6	3 0	0 9
Painting and finishing	3	6	1 6	0 4½
,, ,,	3	6¼	1 6¾	0 4¾
Testing and adjusting	1	6¼	0 6¼	0 1¾
Total	32	..	16 6	4 1½
Average buffing	1	..	..	0 7½
,, other work	7	..	..	3 6¼
	8	..	..	4 1½
,, machine running charges	1	..	..	0 2½
	..	..	..	4 4

Hot-Plate Cleaning.

Time on four Hot-Plates.

	Hours.	Rate. d.	Value. s. d.	Average. d.
Stripping and unpacking	1½	4½	0 6¾	3⅜
Cleaning and drying	1½	4½	0 6¾	
Buffing and repairing	1	7½	0 7½	1⅞
Rebuilding and packing	1½	4½	0 6¾	4
Painting and finishing	2	4½	0 9	
Testing and adjusting	1	6½	0 6½	1½
Total	8½	..	3 6¾	10⅜
Average buffing	½	..	..	1⅞
,, other work	1⅞	..	..	8⅞
	2⅜	..	..	10⅜
,, machine running charges	¼	..	..	⅛
	..	..	..	11

One difficulty which has faced us all is how to deal with the grill pans and drip pans returned, after only a season or two of use. The pan has lost its polish, and no one cares to use a utensil of this sort, no matter how nicely "cleaned up." I made trial first of having a number of tins redipped. This gave a fair amount of satisfaction, but still left much to be desired, and it necessitated the sending of a consignment to the factory, and considerable delay in return of the things. Electro-tinning was suggested, and having already the shafting installed for drills and buffs, the introduction of electro-tinning was a simple matter, and considered well worth a trial, and was installed.

The cost of plant and a first supply of chemicals, including fitting up, but exclusive of shafting and motive power, did not exceed £40. The plant has given every satisfaction. The finished article has a fine appearance, and is taken up by the householder as readily as a new tin. The plant is usually run in conjunction with our other work of grinding, polishing, and drilling. In order to ascertain the cost of retinning as compared with the purchase of new tins, however, the plant was run on retinning alone, and gave the following results:—

TABLE No. VII.—*Working Costs of Tinning Plant.*

	s. d.
Time 9 hours of man at 7¼d.	5 5¼
Gas used for engine, 200 cubic feet	0 6
Gas used for heating chemical bath, &c., 400 feet	1 0
For chemicals, oil, &c. (say)	1 4¾
	8 4

The first cost of material retinned works out as follows:—

	£ s. d.
9 Grill pans, heavy, at 2s. 4½d. each	1 1 4½
9 Drip-pans, assorted	0 6 10
Total value if replaced by new	1 8 2½

An equivalent set of pans of light pattern could have been purchased for 14s.; so the saving as against a set of new pans of light pattern is not so great.

EMPLOYMENT OF APPRENTICES.

Owing to the extension of business by all gas undertakings in fitting-up gas apparatus of all classes, there is a difficulty in securing competent men for the work. The main source from which supplies have been found is the local plumber; and it has been common experience that the average journeyman plumber does not have such intimate knowledge of the best means of fitting-up gas cooking and heating appliances, with the result that the gas

departments are much troubled with complaints arising from the work done by new men entering their service. In fact, the average plumber has to learn the business of fitting-up gas appliances after he has entered the service of the gas undertaking, and at the expense of annoyance and inconvenience to the consumers.

The business of fitting-up apparatus is increasing from year to year, and is likely to continue to increase for some time to come. When a plumber is sent from a tradesman's workshop to fit-up appliances he is usually accompanied by an apprentice, not only with a view to the apprentice being instructed in his trade, but also because of the occasional assistance required from a second hand. There is some need of assistance to a small extent in the case of fitting-up gas appliances; and my experience has been that householders resent the presence in their dwellings of a full-grown man along with the fitter, and that they prefer a young lad, as in the case of plumber work.

The foregoing reasons led me some time ago to the conclusion that efficient service would be better obtained by gas undertakings training their own apprentices. There is sufficient scope for the services of quite a number of apprentices for gas undertakings alone, since these apprentices are thoroughly trained in the matter of fitting-up gas appliances. The extent to which such apprentices could be trained depends on the scope of the work embraced by each undertaking. In the case of Perth, where we have "stove cleaning and repairing" and also "meter repairing" and "tinsmiths" departments, it would be advisable that each apprentice should have a portion of his training in these departments.

On taking up the duties at Perth I found there was a system of apprenticeship in vogue—one of the apprentices having nearly completed his time, a second had served two years, while another two had one year's service. On making inquiries, I found that these apprentices were confined to gas-fitting work; being sent out with journeymen according to the class of work on which journeymen were employed—in fact, were made use of as fitters' helps, and depending in the matter of learning their trade on the goodwill and courtesy of the journeymen to whom they might be engaged. As I did not consider this satisfactory, I gave instructions for the foreman to see that apprentices were given reasonable instruction in their work, and also, following out the lines which I have indicated above, arranging that each of the seniors in turn should have experience in the meter-repairing and stove-cleaning departments.

We had only begun to give effect to this principle when I received a communication from the local Secretary of the Gas Workers' Union intimating that the mechanics in the Charles Street Department had the question of apprentices under consideration, and, in view of certain information received as to the status of gas-works trained apprentices, were afraid that they had no alternative in the future than to abstain from instructing apprentices. When the subject came up for discussion with the District Secretary of the Union, it was agreed that I should ascertain:

(1) If there is a demand for gas-works trained journeymen fitters.

(2) If the journeymen so trained would be guaranteed the standard rate of wages paid to other journeymen fitters.

In terms of this understanding I communicated with all the gas-works in Scotland where two or more gas-fitters were likely to be employed, and with the gas-works in England and Ireland where upward of twenty gas-fitters are employed, and the result is that:

(*a*) Ninety per cent. in Scotland and all the works in England and Ireland indicate that there is an increased demand for gas-fitters for fitting-up gas appliances.

(*b*) That this demand in the future is likely to increase.

(*c*) Sixty per cent. in Scotland and England have experienced difficulty in securing the services of competent men.

(*d*) Sixteen per cent. in England are already training their own apprentices.

(*e*) Ninety per cent. consider the training of apprentices as advisable; 80 per cent. also state it as necessary.

(*f*) All of these would be prepared to employ as journeymen those apprentices who served their time in a gas-works, and in 90 per cent. of the cases would give preference to such men, on account of their more intimate knowledge of the work as compared with the ordinary outside plumber.

I am still without any reply from the Gas-Workers' Union.

EDUCATION OF GAS-FITTERS.

The steps taken recently by the Institution of Gas Engineers to secure a system of inspection and certification of gas-fitters under the City and Guilds Institute will, no doubt, when it is fairly under way, remove much of our difficulty in the matter of securing competent gas-fitters. Your Association has a local Committee appointed to act in conjunction with the Institution of Gas Engineers to arrange for classes in the various populous centres. It is to be regretted that steps cannot be taken for this winter season; but it is hoped that classes will be arranged before the preparation of next year's syllabus.

CONCLUSION.

We have pleasure in welcoming Dr. Lessing as our lecturer on this occasion. His subject is one which, in view of recent research, will be of special interest. A paper dealing with vertical retorts by Mr. Dickson, of Johnstone, and one by Mr. Walter Grafton dealing with the calorific power standard for testing town gas will be submitted to you. Both of these are subjects which should be fruitful of discussion.

Before concluding, I would take this opportunity, on your behalf as well as my own, to congratulate one of our members, Mr. G. R. Hislop, of Paisley, on having completed the term of over fifty years' service as Engineer and Manager of the Paisley Corporation gas undertaking. Mr. Hislop is a gentleman whom we all hold in high esteem; and it is our earnest wish that he may be long spared to retain his membership of our Association and take an active part in its deliberations.

At the conclusion of the address,

Mr. A. MASTERTON (Edinburgh) said he was certain he expressed the mind of all present when he said they were deeply indebted to Mr. Vass for the able and comprehensive address to which they had just had the pleasure of listening. When the address was being read the thought came to his mind of the amount of care, time, and investigation which had been expended in the preparation of it; and he trusted that their appreciation would be partly compensation to the President for the infinite trouble he had taken. The points dealt with interested them all very keenly in their relationship to the gas industry. He (Mr. Masterton) did not think it necessary or even prudent on his part to descant on the merits of the presidential address, so he would merely ask the members to tender to Mr. Vass a hearty vote of thanks for his appropriate and carefully prepared address. He would further ask the Secretary to duly record this expression of their gratitude on the minutes of the proceedings.

The motion was carried amid loud applause.

The PRESIDENT, in acknowledging the vote, explained that the address was prepared in anticipation of the fact that the members of the Association were to be visiting the City of Perth, and this accounted, to a considerable extent, for the local colour which was introduced throughout it.

PAPERS AND LECTURE.

The two papers on the *agenda* were then read and discussed, and the William Young Memorial Lecture was also delivered:

(1) "A Year's Experience with 'Continuous-Intermittent' Vertical Retorts at Johnstone." A Paper by JAMES DICKSON, of Johnstone. This and the long discussion to which it gave rise will appear in next week's issue of the "JOURNAL."

(2) "Catalysis in Gas Manufacture and Application." A Lecture by RUDOLF LESSING, Ph.D., F.C.S., of London—see p. 570.

(3) "The Basis which should Determine the Thermal Value of Gas." A Paper by WALTER GRAFTON, of Glasgow—see p. 573.

ELECTION OF OFFICE BEARERS.

The ballot for the election of office-bearers resulted as follows:

President.—Mr. J. B. Scott, of Cowdenbeath.

Vice-President.—Mr. John Lang, of Alexandria.

New Members of Committee.—Messrs. C. P. Myers, of Troon, and R. Cowie, of Dalkeith.

Mr. J. B. SCOTT (Cowdenbeath) said he had to thank the members very heartily indeed for the high honour they had conferred upon him in electing him President of the Association. He did not know what he had done to merit the distinction, but he could assure them he would do his best to maintain the high traditions of the office; and to the accomplishment of this end he solicited their support and cordial co-operation.

PLACE OF NEXT MEETING.

The PRESIDENT said that, with regard to the place of next meeting, the Secretary had been instructed to write to the Corporation of Perth to ask if, in view of the exceptional circumstances which had arisen, the Town Council of the city would renew their invitation to the Association to hold—all being well—its next annual meeting in Perth. The reply which had been received from the Town Clerk of Perth was to the effect that he had no doubt his Council would be pleased to renew the invitation for next year. He (the President) thought it would be quite safe for the members to leave this point in the hands of the Committee. The original intention had been to hold this year's meeting in Perth, and that the two succeeding annual meetings should be held in Edinburgh—the one under the presidency of Mr. Scott, and the other under the presidency of Mr. Masterton. In view of the letter which had been received from the Town Clerk of Perth, he would move that it should be left to the Committee to arrange for next year's meeting either in Perth or Edinburgh according to which centre appeared to be best in the circumstances.

Mr. J. B. SCOTT here indicated that it was his wish, as it was also the desire of the Directors of his Company, that the annual meeting next year should be held in Edinburgh.

It was eventually decided to adopt the suggestion of the President, and leave the decision in the hands of the Council.

PRESENTATION TO THE PRESIDENT.

The PRESIDENT-ELECT said the unexpected duty had fallen to him of presenting Mr. Vass with the gold badge of the Association, as a memento of his year of office as President.

The PRESIDENT, in replying, said it was with pleasure he accepted the badge as a token of their goodwill and esteem.

The proceedings terminated with a vote of thanks to the President and Secretary for their services.

CATALYSIS IN THE GAS INDUSTRY.

WILLIAM YOUNG MEMORIAL LECTURE

Delivered before the North British Association, Sept. 3.

By Rudolf Lessing, Ph.D., F.C.S.

Mr. President and Gentlemen,—In the first place allow me to thank you for the great honour you have done me in asking me to deliver this year's "William Young Memorial Lecture." The subject I have chosen is perhaps a little too academic for the taste of many of you, and I feel a good deal of apprehension in this regard—more particularly as it follows a discourse of such eminently practical interest as that given to you by my friend Dr. Davidson a year ago. I find an encouragement in presenting to you the somewhat abstruse subject of catalysis in the belief that it is the sort of subject that would have appealed to the man to whose pious memory we do honour to-day. Dr. Beilby, in his "Appreciation of William Young," emphasizes one trait in his character as "the breadth and daring of his attempts to grapple with those bigger problems of matter and of energy which are ordinarily allowed to remain in the dim background of the immediate problems of industry, and the intellectual vigour with which he dragged these big problems into the discussion of the most everyday questions."

This is my justification for dragging some problems which in part are only indirectly of immediate industrial interest, and which are to a certain extent of a speculative nature, into the limelight of discussion, at the risk of "causing some bewilderment to the more practically minded of my hearers," and on the assurance which has been given to me, that a Scotch audience will prove receptive for information, which may require some further thought for its proper digestion.

Catalysis has been known to chemists now for more than a century. The first observation of a catalytic reaction was made by Kirchhoff in 1811—viz., that starch is transformed into dextrin and sugar under the influence of mineral acids, which latter remain unaltered thereby. But Sir Humphry Davy's observation in 1817, that a gently-heated spiral of platinum wire becomes incandescent when placed in a mixture of air and combustible gas or vapour—the latter being at the same time slowly oxidized—has probably become the classical experiment with which the birth of the science of catalysis is usually associated, although it was not until 1837 that Berzelius grouped a number of these phenomena together as "catalytic" reactions—a name already known, though in an entirely different connection, to the alchemists of the Seventeenth Century.

Definition and Theory of Catalysis.

The definition of catalysis most commonly adopted is that given by Ostwald: "A catalytic agent or catalyst is a material which affects the velocity of a chemical reaction without itself appearing in the final products." This definition implies that the reaction must be possible even in the absence of the catalyst, and the latter cannot be capable of starting, but only of accelerating, the reaction. While strictly speaking this is true in theory, it is of little importance in practice, since many reactions may be possible without the catalyst only at temperatures and pressures unattainable by our means, or exceedingly slowly, or under conditions which would affect or destroy the products as soon as they are formed, while with the catalytic agent these reactions are brought about in reasonable time and under workable conditions.

One striking feature of catalysis is that the quantity of the catalyst required is so small, and may be infinitesimal, compared with the amounts of the substances changed under its influence. From this it must not, however, be inferred that the quantity of the catalyst is quite immaterial; for in certain cases, its bulk and particularly the extent of its exposed surface are important.

Many theories have been advanced as to the way in which a catalyst exerts its influence. According to one commonly accepted view, a catalyst is effective because it combines chemically with some of the reacting substances to form unstable intermediate compounds, which in their turn break-up into the final products, the catalyst being liberated and free to combine again. According to another conception of catalysis, the efficiency of the catalytic agent is due to physical causes, depending on the occlusion or adsorption of the reacting substances on its surfaces and in its pores. The higher concentration of the reagents thus secured is responsible for the greater velocity of reaction. The electric theory recently advanced, but not generally accepted, may be left out of consideration, since it depends primarily upon the occlusion already referred to.

The catalytic agent may be a gas or vapour, a liquid or a solid, and is not restricted in its composition to any particular class of substances. Examples for these varieties are the nitric oxides in the chamber process of sulphuric acid manufacture, the traces of water vapour necessary for the explosion of gas and air mixtures, the liquids acids used in the inversion of cane sugar, the platinum in Davy's experiment, or the iron oxide in the Claus kiln.

The Industrial Application of Catalysis.

A vast number of processes in pure and applied chemistry depend on, or make use of, catalysis. It is, therefore, not surprising that we find among the numerous chemical changes involved in the carbonization of coal and the working-up of its products many which are either wholly dependent upon catalytic action, and many for whose mysterious complexity catalysis offers a feasible, if not the only, explanation. Indeed, if we follow the course of treatment which coal undergoes from the mine where it is gotten to the burner or chimney-flue whence its gaseous remains escape into the atmosphere (spent and bereft of all energy), there is scarcely a step in the manifold changes on which catalytic influences have not some bearing.

Catalysis in Coal.

Even in the operation of mining itself they can be traced. It is now well known that the cause of explosions in coal mines is to be found more in the coal dust suspended in the mine air than in the inflammable gas mixture called "fire-damp." In fact, such dust is capable of being ignited and of propagating explosion in the absence of an inflammable gas mixture. The remedy first suggested by British mining engineers, and advocated by the Government Committee charged with the study of the question, consists in the sprinkling of inert stone or shale dust on the surfaces of the hauling roads in the mine, which covers the combustible coal dust and renders it apparently incapable of starting or propagating explosions.

In 1882, Sir Frederick Abel laid emphasis on the view that the dust "exerts a contact or catalytic action upon gas mixtures similar to that known to be possessed by platinum." While Abel's interpretation of results has not found favour by those best able to judge—particularly inasmuch as he saw an element of danger even in non-combustible dust—I incline to the belief that his theory contained the kernel of truth, and that it affords at any rate a very plausible explanation of the ignition of *combustible* dust particles (without having any recourse to the "coarse gas" hypothesis).

It is quite conceivable that the physical structure of combustible dust will be such as to favour the occlusion, and thereby concentration and compression, of gases on the surface, which might go so far as to induce, on the slightest provocation, combination of oxygen and fire-damp in the case of inflammable gas mixtures, or spontaneous combustion of the coal substances, if air only is occluded, or both reactions will go side by side. The coal dust thus acts as catalyst by reason of its physical structure. It is only secondarily attacked by the heat evolved, and gives off combustible vapours by carbonization, which in its turn might be catalytically affected by the composition of the coal dust particularly as regards its mineral constituents. The heat evolved will be sufficient to propagate explosion.

Whether the salutary effect of non-combustible stone or shale dust may be due to its acting as a "retarding" catalyst is a matter of speculation.

Spontaneous Combustion.

Similar considerations apply to the case of the spontaneous combustion of coal, which causes trouble both in mines, where it leads to "gob fires," and in the storage of coal in bulk. The older theory, that the presence of pyrites played an important part, has been practically discarded in view of the fact that the organic matter in the coal on oxidation by atmospheric oxygen furnishes sufficient heat to explain the phenomenon of spontaneous combustion. But there is little doubt that this oxidation is largely influenced by the chemical constitution of the coal, and the mineral constituents act probably as catalysts in promoting or inhibiting oxidation. In this connection, some recent work by Hofmann, Schumpelt, and Ritter should be mentioned. They found that carbon of different origin—such as lamp black and even retort carbon—could be oxidized at temperatures below boiling point by means of dilute solutions of potassium chlorate when catalytically activated by osmium tetroxide or by solutions of bleaching powder yielding carbon dioxide, mellogen, and mellitic acid.

Catalysis in Carbonization.

If we therefore take it that coal is subject to catalytic influences even at ordinary temperature, when it is chemically almost at rest, and when it is only in contact with air or traces of gas which one would not expect to react with it to an appreciable extent, how much more must these influences assert themselves when coal is raised to temperatures so high that its molecules suffer destruction beyond recognition, and that the bonds of affinity between its components are severed and the reactivity of the fragments reaches its highest. It does not require a great deal of imagination to see that the conditions under which coal is carbonized, and the complexity of the coal substance itself (which always includes a certain amount of mineral matter), offer great possibilities for catalytic reactions.

Influence of Retort Material.

The very vessels in which carbonization takes place are made of materials which, in the circumstances, must act as catalytic agents.

We know that the primary products from coal suffer decomposition on coming in contact with the heated wall of the retort, or with coke already raised to a state of incandescence. Now all thermal decompositions of organic substances must be grouped in two classes: (1) Those produced by the action of heat alone; (2) those produced by heat, but necessitating, or accelerated by, the presence of some foreign substance with which the vapours come in contact, and which acts as a catalyst.

The record of many valuable researches by eminent chemists, on the synthesis and decomposition of hydrocarbons by heat—from Berthelot's famous synthesis of benzene by passing acety-

lene through heated porcelain tubes, down to Bone's observation that the decomposition of methane is accelerated by contact with quicklime, and Professor Cobb's recent investigation on the influence of red-hot coke on the products of combustion—show clearly that most of these reactions belong to the second group, and that the nature of the heated reaction vessel, or the material with which it is packed, are most essential factors.

The deposition of carbon on the retort walls is largely the result of such a contact decomposition. Now, if the retort walls are capable of favouring such a reaction, it stands to reason to expect that the amount of decomposition, and the direction in which it proceeds, must be influenced by the physical structure and the chemical composition of the material from which the retorts are made. Useful information might be obtained from reliable tests as to the influence of a smooth or porous surface layer on the decomposition of hydrocarbons. Glazed retorts would probably show a different behaviour in this respect from unglazed ones, quite apart from the question of permeability to gas. Further, it is quite probable that the chemical composition has some bearing. In this connection it would be interesting to compare retorts made of silica with those made of highly aluminous fire-clay; and again, where temperature permits, with iron retorts. There is bound to be some difference in the catalytic effect of these, unless all the theoretical work upon the influence of catalysts on pyrogenetic reactions—such as that carried out by the Russian chemist Ipatieff—is inapplicable to practical working.

It must, of course, be borne in mind that in ordinary practice the retort surface is partially covered by carbon, except immediately after "scurfing;" but this carbon itself is a catalytic agent, and induces further decomposition.

The importance of the catalytic or contact action of the retort material was clearly recognized by William Young, though not expressed in so many words. By his "radiant heat" theory he aimed obviously at the fixation of hydrocarbon vapours by heat in such a way that the rapidity of complete destruction was not intensified and accelerated by the catalytic influence of the retort walls.

Catalytic Effect of Mineral Constituents.

While the retort walls offer a contact surface only to the primary products of distillation as far as they are in vapour form (except where they are in direct contact with coal), the process of carbonization is more directly affected by those constituents of the coal which are capable of acting as catalysts—particularly the mineral substance.

The possibilities of catalytic activity of the coal ash are only surpassed by the complexity of chemical changes occurring in this common and yet so little understood process of carbonization. If we once realize—as we have reason to do, from the analogies of many well-investigated cases in other branches of chemistry—that mineral substances such as commonly accompany the coal substance are eminently capable of acting as catalysts, then these possibilities will soon become manifest.

The reactions which occur in carbonization may be grouped under these headings:—

(1) Oxidation.
(2) Dehydration.
(3) Thermal decomposition of heavy hydrocarbons.
(4) Formation of benzene and other ring compounds.
(5) Hydrogenation or reduction.

If we assume the "free moisture" to be driven from the coal, the first rise in temperature would tend to promote combustion—*i.e.*, "oxidation" of some coal substance by oxygen which is physically occluded or chemically bound in coal, forming carbon dioxide, carbon monoxide, and some water. Some oxygen which is directly linked to hydrogen in the coal molecule is next removed by "dehydration" in the form of water, which serves to dissolve the ammonia and appears as gas liquor.

The coal substance deprived of its oxygen may be regarded as a mixture of very high-molecular hydrocarbons, which, at the temperature the charge has reached by now, suffer "thermal decomposition" into smaller fragments—viz., gaseous hydrocarbons and hydrogen, tar vapours, and coke. The gaseous hydrocarbons again unite, forming aromatic "ring compounds" such as benzene, naphthalene, &c.

Some of the unsaturated hydrocarbons are "hydrogenated" by the addition of hydrogen.

These reactions must not be taken as giving a true sequence of events; in fact most of them being reversible in themselves and overlapping each other, it is impossible with our present means to disentangle the threads. But they are set out as types of reactions which probably occur during carbonization; and it is remarkable that one and all of these types are known—by independent researches—to be liable to catalytic influence.

The catalytic material is amply furnished by the coal ash. The latter is partly inherent, and so finely divided throughout the coal, that it is impossible to separate it. In part, it is only mechanically admixed. But even the latter portion combines more intimately with the coal substance proper during the period of semi-fluidity; so that it is inseparably united with the resultant coke.

Granted, therefore, the required intimate contact, it remains to inquire in what directions the ash may influence carbonization catalytically.

The Coal-Liming Process.

In my opinion the chemical composition of the ash, or to be more correct the mineral matter, plays a certain part in determining the course of decomposition that a coal undergoes on carbonization. In order to illustrate this, I need only remind you of Cooper's coal-liming process, which has of late years been so successfully revived and modified by Mr. R. O. Paterson, of Cheltenham. The fact that the addition of a minute quantity of a certain mineral substance—*e.g.*, lime—to the coal does away with stopped ascension pipes and scurfing troubles, is proof of the far-reaching influence of a catalyst. And there cannot be the slightest doubt that the lime acts in this case catalytically; accelerating the primary formation of permanent gas and of such tar vapours as are not liable to excessive decomposition down to solid carbon.

Advantages have been claimed for various processes in which lime either in the form of limestone or quicklime is added to the coal, covering both low and high temperature carbonization. In certain cases it has been proposed to add sufficient lime to neutralize the acid portions of a highly siliceous ash.

Mention might be made of Hempel's theory. He attributes the hardness of coke to the formation of silicides similar to carborundum during carbonization, assuming a reduction of silica and its combination with carbon.

Whatever the value of such proposals, there cannot be any doubt that much advantage can be gained by a more careful study of the mineral constituents of coals and their artificial modification than has been attempted hitherto.

Although occasional attempts have been made to investigate the composition of mineral matter as it actually exists in coal, our knowledge is practically restricted to its oxidized condition—that is to say, to the true ash after all the combustible matter has been burnt off. I need only refer to the iron contents to make it clear that this metal can never exist in coal in the form in which we usually record it in analysis—namely, as ferric oxide, Fe_2O_3.

Matters become still more complicated at temperatures where the mineral constituents are likely to react with each other, or with the organic coal substance. Basic oxide may combine with silica to form silicates or "slag;" silica may be reduced by hydrogen or hydrocarbons to silicon; iron pyrites, of course, will first part with some sulphur, and may then even be reduced to metallic iron of a form which would be catalytically particularly active. It is to be expected that some of the inorganic constituents, being very finely subdivided among the coal substance, have a catalytic effect upon the decomposition of the latter which is not inferior to that exerted by the retort-walls.

I myself am at present engaged in an investigation of the influence of mineral matter upon carbonization. I regret that the results are not sufficiently far advanced for publication; but I am satisfied that the influence exerted by various substances on the resultant products differs considerably according to the chemical nature of these substances.

Influence on Nitrogen and Sulphur Compounds.

So far we have only considered the bearing of catalysis on the main products of carbonization. But it is not less important in connection with the nitrogen and sulphur compounds. We know again that by the coal-liming process the ammonia yield is increased and the formation of organic sulphur compounds diminished. Why should the addition of a minute quantity of lime bring about such a result under otherwise equal conditions? A reply can be found in researches based on a fundamental paper published in 1901 by Dr. G. T. Beilby, William Young's friend and collaborator, and Professor G. G. Henderson, of Glasgow. They were able to establish the fact that metals are capable of absorbing ammonia at elevated temperature, forming nitrides (such as Fe_4N_2, Cu_3N) which are easily decomposed again by steam or hydrogen. Subsequent workers occupied themselves particularly with the nitrides of silicon and aluminium. Indeed, many processes have been patented according to which such nitrides are formed with atmospheric nitrogen yielding ammonia on decomposition with water. The fact that alterations in the composition of coal ash make a difference in the ammonia yield, render it probable that intermediate nitride formation has some influence in converting the nitrogen which we must assume to be present in coal in organic combination into ammonia, and they possibly determine also the ratio of cyanogen to ammonia.

As to sulphur compounds, since catalysis plays so large a part in their decomposition, as seen later, the same must hold good for the reaction in the reverse direction—their formation.

Catalysis in the Water-Gas Process.

Similar considerations as in the case of carbonization apply to the water-gas process. The reactions being here somewhat less complex, a good deal of exact experimental work has been carried out, particularly on the water-gas equilibrium at different temperatures. Catalysts are capable of influencing this very largely. Reference may only be made to the work of M. Vignon, who found that the percentage of methane in water-gas can be largely increased by the addition of lime to the coke.

The following figures give the ratio of hydrogen to methane in water gas made from coke to which varying quantities of lime had been added:—

Lime added to Coke.	Hydrogen.	Methane.
10 per cent.	88	12
15 ,,	81	19
50 ,,	77	23

A very promising application of catalysis in connection with water gas lies in the direction of transforming the mixture of hydrogen and carbon monoxide into methane.

The French chemist, M. Paul Sabatier, who has been the most successful worker in the domain of catalysis during the last seventeen years, suggested jointly with Senderens that carbon monoxide and carbon dioxide could be "hydrogenated" to methane by means of finely divided nickel at from 200° to 250° C., according to the following equations:—

$$CO + 3H_2 = CH_4 + H_2O$$
$$CO_2 + 4H_2 = CH_4 + 2H_2O$$

Others took up the idea—notably Elworthy, an English engineer, and later Erdmann and Bedford, who proposed to remove the troublesome sulphur impurities in the crude gas by liquefaction. The difficulty is that the hydrogen percentage in water gas is only about one-third of the amount required by the carbon monoxide. A number of other catalysts have been investigated. If the new methods for the production of cheap hydrogen—also largely based on catalytic reactions—can be so perfected as to bring this gas within the range of gas-works economics, then there is every reason to hope that by a judicious combination of water gas and hydrogen plant, the catalytic conversion of the gas mixture into methane, a non-poisonous gas of high calorific value, can be brought about at a reasonable cost. This would at the same time constitute a most perfect solution of the problem to dispose of surplus coke.

Purification.

If we now follow the gas on its course in ordinary works practice, we come to two stages of purely physical treatment—the condensation of tar and the scrubbing of ammonia. These operations being only indirectly dependent on chemical reactions, there is obviously little scope for catalytic influence. However, once these bye-products are recovered, catalysis again plays an important *rôle* in their working-up; and considering the economic dependence of the gas engineer upon the value of these bye-products, he cannot afford to shut his eyes to the possibilities in this direction.

It may perhaps be more convenient to delay for a little the consideration of the relation of catalysis to bye-products and accompany the gas on its way to the holder.

The next stage is purification from sulphuretted hydrogen. The reaction proceeding in the iron oxide purifier, although perhaps not strictly covered by the term catalysis, affords an excellent example of bringing home to the lay mind the meaning of this mysterious force in a more palpable way. Briefly (and disregarding chemical subtleties), the mechanism of purification consists in the following changes: Iron oxide combines with sulphuretted hydrogen to form iron sulphide and water vapour; iron sulphide is oxidized by air, whereby the original iron oxide is re-formed and sulphur is liberated. The sum-total of these reactions is that sulphuretted hydrogen has combined with oxygen according to the equation:

$$2H_2S + O_2 = 2S + H_2O.$$

But this reaction or the reactions which led up to this final result were only possible by the aid of the iron oxide which acted as the catalyst remaining, to all intents and purposes, unchanged. If the two operations in the process, the fouling and revivifying, are done intermittently, the former in the box and the latter outside, then this (if I may use the term) "protracted catalysis" is enacted in two definite stages. But if revivification is done *in situ*, by air added to the gas, then the process approaches more nearly a true catalytic action. In practice, the action comes to a stop when the oxide is spent. This is simply caused by the blocking-up of the surface of the oxide by so much sulphur that neither air nor sulphuretted hydrogen has any access to it. If we would imagine some contrivance by which the sulphur formed would continually be removed—say, by a non-volatile solvent—then the reaction would go on indefinitely, without appreciably impairing the activity of the iron oxide. This example might at the same time serve to illustrate quite crudely what is termed the poisoning of a catalyst. Catalytic agents are liable to be rendered sluggish or inactive by certain impurities. In our case the product of reaction, sulphur, would itself act as the catalytic poison. The common experience, that the more active a catalyst the more susceptible it is to poisoning, finds also an analogy in the purifier box; for it is well known that a very highly active oxide generally loses its avidity for sulphur much quicker than one of average activity.

Removal of Carbon Bisulphide.

The problem of the removal of the minute quantities of sulphur which the gas still contains in the shape of organic sulphur compounds, has called forth a remarkable application of catalysis on a grand scale. The brilliant lecture recently delivered by Mr. Charles Carpenter, D.Sc., before the Institution of Gas Engineers furnishes the proof, if proof be needed, of the enormous possibilities offered by a judicious recognition and workmanlike use of catalytic principles. The contents of this lecture are by now too well known to gas engineers to bear reiteration of a detailed description of the process and the steps that led up to its perfection. The reaction upon which the process is based is expressed by the equation:

$$CS_2 + H_2 = 2H_2S + C$$

and takes place with nickel as catalyst at about 430° C. The way in which Mr. Carpenter and his collaborators, Messrs. Evans and Franks, after many difficulties and disappointments, succeeded in translating the stimulating effect of catalysis from the laboratory experiment to the largest scale, must serve as a model of progressive methods in modern industry.

A promising proposal for the same purpose (and referred to in Mr. Carpenter's lecture) has been made by M. Oscar Guillet. His process is based on the interaction of carbon bisulphide and water, according to the equation:

$$CS_2 + 2H_2O = CO_2 + H_2S$$

brought about by iron oxide as catalyst at a temperature of only 130° C. When this process has emerged from the laboratory scale it is likely to require a very simple plant indeed, in view of the comparatively low temperature required, and since it practically consists in keeping the ordinary purifiers at the temperature mentioned.

Catalysis in Relation to Bye-Products.

At this point we might profitably return to the consideration of catalytic questions affecting the bye-products works.

In the tar still the catalytic action of impurities is probably responsible for the degree of decomposition by superheating, and catalysis must be looked upon as a factor in the corrosion of the stills.

The effect produced by adding a small percentage of sulphuric acid to the tar is undoubtedly a catalytic phenomenon, as is also the purifying effect of this acid or other reagents added in minute quantities for the purification of the various distillates.

As an instructive example of a catalytic reaction by which a tar derivative is turned into an intermediate product for the dye-stuff industry, the oxidation of naphthalene to phthalic acid by means of sulphuric acid may be quoted. The result depends upon the addition of a trace of mercury to the mixture. This discovery forms quite an episode in the history of invention, for it was made by accidentally breaking a thermometer—the mercury setting the reaction going. This process, in conjunction with the catalytic process of sulphuric acid manufacture, enabled the synthesis of indigo to become a commercial possibility. One application of catalysis which is likely to become of importance in the very near future is the methodical "cracking" and hydrogenation of hydrocarbons. The craving in modern times for light motor spirit occasioned the "invention" of a number of processes for the conversion of heavy oils into light hydrocarbons. Catalysts such as iron or nickel are employed in most cases.

Such processes can only be successful if also efficient means for the "hydrogenation" of—*i.e.*, the addition of hydrogen to—the products of decomposition are employed. While petroleum oils are already being treated on a commercial scale, it is to be expected that coal-tar oils will in time also be submitted to such processes.

The sulphate of ammonia department depends on catalytic reactions in various ways. The waste gases from the saturator are either passed through oxide of iron or burned directly for acid manufacture, or treated in the Claus kiln. The latter is a typical example of a catalytic process on which experience has been gained for many years. The reactions it involves are practically those discussed in connection with the oxide purifier—viz., the oxidation of sulphuretted hydrogen to sulphur by air in contact with oxide of iron—the only difference being that it is carried out at a temperature at which the sulphur is prevented from being deposited on the catalyst. The influence of various catalysts has been studied in great detail, notably by the late Chief Alkali Inspector, Mr. R. Forbes Carpenter.

The sulphuric acid required for sulphate making is itself a product of a catalytic reaction, for the nitrous oxides by which sulphur dioxide is oxidized in the lead chamber are acting as a catalyst. The "contact" process for making sulphuric anhydride and sulphuric acid of any strength means a more conscious application of catalytic principles than the old chamber process. It does away with the bulky and costly lead chambers, and brings about the oxidation of the gases from pyrites kilns by air in a confined space by the aid of platinum or iron oxide catalysts.

Synthetic Ammonia and Nitric Acid.

Two processes which may affect the ammonia maker—one as a possible outlet for the product, the other by furnishing competing quantities of the product—must not be forgotten. The first is Ostwald's process for the catalytic oxidation of pure ammonia to nitric acid. This is carried out by means of platinum as a catalyst. At first sight there might seem to be little object in turning one form of combined nitrogen into the other when its value as a fertilizer is only considered; but the aim is to make the chemical, and particularly the explosive, industry in Europe independent of the natural saltpetre from Chili for its much-needed supply of nitric acid. If worked on a large scale, this process might relieve the ammonia market to some extent.

The other is the production of synthetic ammonia from its elements. For this purpose several processes have been proposed—*e.g.*, by Serpek—which have the formation of silicon or aluminium nitrides as basis. But Haber's process, worked out on an industrial scale by the Badische Company, is one which is already in competition with ammonia from gas-works, more particularly as regards anhydrous ammonia. It consists in the direct combination of hydrogen and nitrogen in the presence of catalysts under high pressure and at a high temperature. Osmium, uranium, tungsten, and tungsten carbide were originally used; but cheaper

catalysts, such as iron, to which definite additions of auxiliary catalysts are made, are now employed. The difficulties of applying the process on the large scale may be realized by the fact that it is carried out under a pressure of about 3000 lbs. per square inch, and at temperatures between 500° and 600° C. A plant said to have an annual capacity of 3000 tons of ammonia is already working. The hydrogen required is made from water gas by a catalytic process.

Conclusion.

The examples quoted will sufficiently prove that catalysis has a not inconsiderable bearing on the bye-products from coal distillation and their working-up, and one that is not inferior to the *rôle* played by it in the processes of gas manufacture proper. However, its influence is by no means at an end at the point where the gas completely purified enters the storage holder. We know, for instance, that in the holder itself, as well as in the distributing mains and service pipes, catalysis has been recognized as a factor in setting up corrosion of the metal.

We might accompany the gas still further on its way to the consumer, and inquire into cases where catalytic influences obtain among the innumerable modes of its application. Enticing as this task would be, I need only mention such problems as surface combustion and illumination by the incandescent mantle, both of which are influenced by, if not depending on, catalysis, to indicate how wide a range is covered by the actions of this phenomenon in one form or another.

It would be practically impossible to compress the consideration of all these cases into the narrow compass of one lecture. As it is, I fear I have not been able in the short space of time allotted to me to do justice to the details of the many problems I put before you, nor even of the processes alluded to; but I have only been able to skim the surface of the available information. Should I have succeeded in arousing the interest of some of you in problems, the importance of which is only beginning to be realized, and to have enlisted the co-operation of a few in the work of applying the results of scientific study to the practical needs of the day, I should feel gratified to think that the memory of William Young has been honoured in the true spirit.

The President said they had had that day a record established in connection with the "William Young Memorial Lectures" that would be looked back to and compared with interest as the directions indicated were more fully applied to science. They had enjoyed a splendid lecture from Dr. Lessing, who had pointed out the many ways in which catalysis might affect the manufacture, purification, and distribution of their gas. They were deeply indebted to the lecturer for the amount of research work he had been putting through his hands with a view to laying his ideas before the Association. He (the President) had pleasure in moving a very cordial vote of thanks to the lecturer.

Mr. Laurence Hislop (Uddingston), in seconding, said that unfortunately the lecture did not appeal to a great number of the members, because it was rather—if he might so put it—more of a University address. At the same time, he (the speaker) thought it would be profitable to them all if they sat down and studied it. Personally, he looked forward with pleasure to the time when he would be able to peruse the lecture at his leisure, and study it much more carefully when it later on appeared in their printed "Transactions." Doubtless, most of the members would then find it very interesting.

The vote of thanks was heartily passed.

Dr. Lessing, in acknowledging, said that as he told them at the outset, he was rather afraid the subject might be too academic for some of them. While perhaps he had only spoken to a few, he hoped that the members would sit down and bring their practical knowledge and experience to bear on the questions he had raised, and make capital, if possible, out of them.

BASIS WHICH SHOULD DETERMINE THE THERMAL VALUE OF COMMERCIAL GAS.

By Walter Grafton, of Glasgow.

[A Paper read before the North British Gas Managers' Association, Sept. 3.]

The consideration at an annual meeting of a topic like the calorific value standard is not only desirable but needful by the members of the North British Association, in order that we may the more clearly understand its technical significance and bearing on the manufacturing aspect of a gas undertaking.

The contribution by Mr. Jacques Abady to the Institution of Gas Engineers last June was one merely to place in the "Transactions" of that body a brief historical account of what has transpired during the past few years in the transition of the illuminating power standard for the calorific value one placed on the gas we sell. It is in the interests of the consumers that statutory protection of some kind is imposed.

The first business of a gas undertaking is to have the right kind of goods to sell, be it gas or coke. "Gude wares mak' a quick market." The fundamental principle is naturally that we shall give the public what they want, and at all times suitable to the requirements and of full value. Value comes first, and must always come first. Therefore the real point of importance is to sell to our customers something that will carry the maximum amount of satisfaction with it. By so doing, they will not cease to patronize us. A gas undertaking's whole anxiety to-day is to supply gas at the lowest price, and which would best please the public.

In the past (and the same holds good with many gas undertakings to-day), we have supplied gas not the most suitable for requirements and of more than full value. This is considered to be to the credit of the undertakings; but it has entailed a higher price than was necessary for the gas, when another quality of a more efficient all-round value would be suitable for the consumers' requirements and cost less money.

Parliament and Standard Thermal Value.

Let us consider for a time the basis upon which Parliament has arrived at the value of 540 B.Th.U. gross as the standard, in place of the illuminating one of 14 candles. At the same time a secondary standard has been allowed in all but one case, which has been called a margin, to cover any error there may be in the production of the gas, before penalties will be imposed.

The basis of fixing 540 B.Th.U. gross may be said to be the outcome of the "test for information" imposed by the London Gas Act of 1905, and which continues in this respect to date, though the Gas Light and Coke Company's Act of 1909 imposed upon that Company penalties for deficiencies below 496 units. The two other Companies affected by the 1905 Act are still producing daily tests for information. Now, the writer believes the true basis that has been used is the illuminating power test, as determined by the No. 2 "Metropolitan" argand, and which is generally believed to be the "most suitable for obtaining, and in making the test shall be so used as to obtain, from the gas when consumed at the rate of 5 cubic feet an hour, the greatest amount of light." With this burner it is not possible to obtain that which Parliament provided should be obtained from the gas, in the interests alike of supplier and user. Had the best burner been employed, a very different heating value would have been recorded as representing or equivalent to 14-candle gas.

The "Metropolitan" No. 2 Test Burner.

In the first place, the "Metropolitan" No. 2 burner, with the exception of the air-regulator, was the outcome of the writer's own research work. His inability to be anything but thorough made his progress slow in designing at that period a burner that would meet all the requirements of modern gas supply. One had to consider coal gas of many kinds, carburetted water gas of all qualities, as well as mixtures of varying composition, each and every one to be capable of being consumed by the one burner and at all times to obtain from the gas at "5 cubic feet an hour the greatest amount of light." The burner as it then stood was shown to Mr. Carpenter by the writer; and he naturally was struck with the results obtainable with it. The writer has the very greatest respect for Mr. Carpenter; and he does not wish any wrong interpretation to be put upon his remarks with reference to Mr. Carpenter's share in the development of the No. 2 "Metropolitan" burner as it now stands. Nevertheless, the burner is defective, because only two of the three air supplies are subject to any regulation whatever.

It will be readily understood that when one checks two air currents of an apparatus which are under the influence of a chimney draught, and which pull can at the same time affect the third or outer air supply, this last is subject to variations over which there is no control. Hence the gas, according to the position of the regulator, is often unduly influenced detrimentally.

With coal gas the effect is not so marked, but with carburetted water gas it is very pronounced, as the following tests will show by using the No. 2 "Metropolitan" burner as supplied and prescribed for use with a 6-inch chimney and 5 cubic feet per hour, and also with its third air supply cut off.

Full Air Supply.	Regulated to Verge of Smoking. *	Regulator about Half Turn Open.	Third Air Passage Shut.		Grafton Regulation.
			Central and Middle Supply Open.	Regulator Closed to Verge of Smoking.	
12·37	15·63	..	15·63	16·75	18·29
14·23	15·70	17·32	16 35	18·13	19 13

* Gas Referees' official method.

The true value is shown in the last column, and to what extent the interests of the gas industry are affected.

Avoiding any interference with the third air current, the following are typical results obtainable by the Carpenter method (C.V.S.) as against the Grafton method (G.V.S.) of regulating the air to the verge of smoking; and it is clearly shown which method develops "the greatest amount of light." The calorific value is also given.

Carburetted Water Gas.

C.V.S.	Half Turn Open.	G.V.S.	Gross B.Th.U.
11·40	12·34	14·14	460
13·97	14·45	17·05	477
16·03	16·92	18·11	489

Mixtures of Coal and Carburetted Water Gas.

14·01	..	15·48	537
14·43	..	15·81	540

Coal Gas.

15·43	..	16·51	580

Efficiency of the "London" Regulating Argand.

The old No. 1 "London" argand, when fitted with a regulator that will control the whole of the air supply [as fig. 1], is quite as efficient as the No. 2 "Metropolitan," and more so if the gas be burned at such a rate as will produce a 16-candle flame.

Coal Gas.

No. 2 "Metropolitan."	No. 1 "London" Regulating Argand.	
5 Feet per Hour.	5 Feet per Hour.	16-Candle Basis.
C.V.S.*	G.V.S.	G.V.S.
13·84	13·54	13·85
14·19	14·00	14·27
14·66	14·42	14·87
15·70	17·00	17·18

* Official Method.

Mixed Gases.

No. 2 "Metropolitan." 5 Feet per Hour C.V.S.	No. 1 "London" Regulating Argand.		Grafton Parliamentary 15-Hole.
	5 Feet per Hour G.V.S.	16 Candle Basis G.V.S.	
13·90	13·88	14·18	14·92
14·08	14·13	14·43	15·41
14·66	14·46	14·65	15·79

Carburetted Water Gas.

14·00	15·36	..	17·09
16·05	16·34	..	18·40

Importance of Illuminating Power Tests.

From the foregoing it is abundantly clear that commercial gas supplied to-day, as tested by the No. 2 "Metropolitan" burner is very much undervalued in respect to its illuminating power; while its heating value is practically right. Hence the heating value that should represent 14-candle average gas is too high. The correct gross heating value of 14-candle gas should be 34 and not 38 B.Th.U. per candle; the former representing 475 B.Th.U. gross and not 540 B.Th.U. per cubic foot. The former value should be the absolute standard, with no range or margin; but should the gas fall below this minimum, there should be another test on the same day, and the average of the two tests deemed to be the calorific value of the gas supplied on that day. If the average value be more than 5 units below the standard, then the undertaking would be liable to a penalty.

Incidentally, it may be considered that the illuminating test by the No. 2 "Metropolitan" burner is quite satisfactory and the tests from day to day accurate to within a percentage of each other; yet they are inaccurate in so far as they do not represent the "greatest amount of light" capable of being developed from the gas. Where an undertaking has an argand that fully develops the maximum light, there is nothing to be gained by substituting for it a thermal test. By having the illuminating tests they are a safeguard against non-luminous gas, and insure illumination for the flat-flame burner users.

The Gas Act of 1868 is still in force in numbers of towns. The Widnes gas undertaking is believed to work under it. Now the gas supplied in that town is tested by the writer's parliamentary standard argand [fig. 2], having 15 holes and 7-inch chimney; and what do we find as the result of its use, combined with the able management of Mr. Isaac Carr? That gas is sold at 8d., 10d., and 1s. per 1000 cubic feet. This is, in consequence, the cheapest gas in the kingdom. A thermal test would not make this gas supply any cheaper; but the adoption of the writer's maximum-value burners has done and can do so.

It makes practically no difference in working by the illuminating test. Provided one gets the maximum value, it is as good as the thermal one, and serves every purpose of protecting the public as to its heating value. Illuminating value safeguards calorific value; and it is cheap gas that is needed.

The Real Thermal Value Standard.

Now, reverting to the thermal value, the real standard is the minimum one; and with this properly and fairly assessed, there is absolutely no need for any margin at all. This would be the absolute working standard; but the one fixed should be one that it is perfectly well known could be maintained without trouble by the gas undertaking. Such a fixed standard need only be provided by the safeguard that another test should be made upon giving notice to the gas undertaking after the lapse of one hour. Should the mean of these testings fall short by not more than 5 units the gas undertaking would not be penalized; but on any excess penalties would be imposed and graduated according to the magnitude of the deficiency.

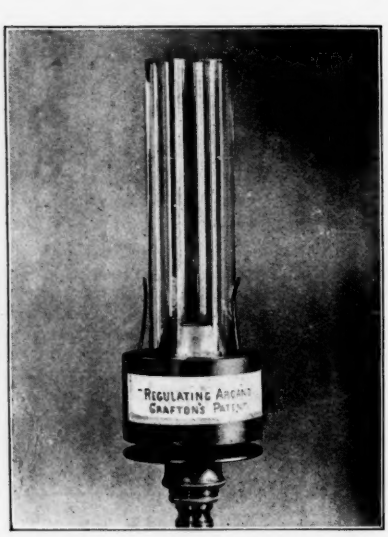
This method gives the gas company all the power they require. It is difficult to realize the advantage to be gained by having the higher standard figure, when the lower one is the real standard below which penalties start. To a customer whose sense of measure is keen, he would only look on the quality of 510 B.Th.U. as deficient in heating value by 30, and to this extent would consider he was being "done," although, as a matter of fact, receiving what the writer would call standard quality gas. It would not be easy to satisfy this class of customer.

Look at the case where the standard is a fixed one of (say) 475 B.Th.U. gross, and the gas supplied at 510 units. All one has to say to a customer is that the gas is 35 B.Th.U. above the requirement fixed by Parliament. The same applies if he were to read test reports in the papers. All consumers would feel satisfied, but not so were the standard 30 or 40 B.Th.U. higher than the quality supplied. Really there is no limit needed in the upward grade. The higher the quality supplied, the greater should be the contentment—provided the price is not raised; for one quality of gas safeguards another requirement, but so soon as its value falls below the standard the consumer is protected by fines. No gas undertaking ever desired to willingly rob its customers by supplying them with gas of less value than they pay for. Unavoidable cause or accident is quite another matter.

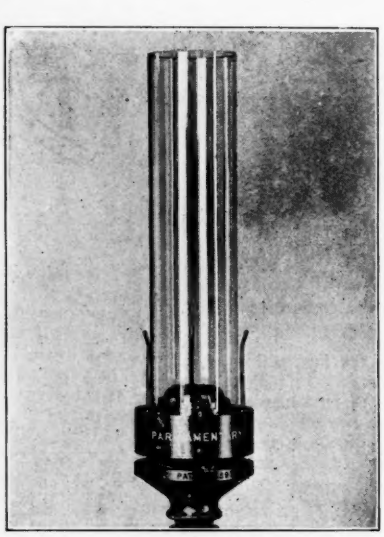
Influence on Calorific Value of Bunsen and Luminous Flames.

One difficulty presents itself by way of the apparatus to be employed and the method of use, in order to obtain the maximum or gross total heat-value from the gas. It is not the desire of the writer to discuss in detail the merits of the calorimeters on the market, but the influence on the calorific value by using bunsen flames or luminous flames.

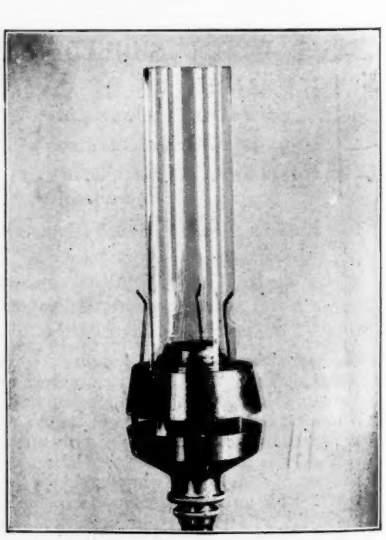
With the Junkers calorimeter and bunsen burner fitted with an



"London" Argand with Regulator Attached.



Grafton's "Parliamentary" Standard Argand.



Grafton's "Ideal" Argand.—See table, p. 575.

TABLE *Showing the Economy to be Obtained in the Manufacture of Carburetted Water Gas by More Careful Treatment of Oil in its Gasification.*

Cubic Feet per Gallon.	Gross B.Th.U. per Cubic Foot.	B.Th.U. per Gallon.	Percentage Increase.	How Purified.	CO_2 in Finished Gas. Per Cent.	Illuminating Power.		Oil Used per 1000 Cubic Feet.	Estimated Cost per 1000 Cubic Feet. Pence.†
						Grafton "Ideal" Argand.*	Percentage Decrease in Light.		
I. 370	614	227,180	0·0	Lime	*Nil*	24·50	0·0	2·72	11·26
II. 497	552	274,344	20·7	Lime	0·4	20·33	17·0	2·01	8·59
III. 603	500½	301,802	32·8	Oxide	7·5	16·65	32·0	1·66	7·42
IV. 618	514½	317,961	40·0	Lime and Oxide	0·5	18·43	24·8	1·61	7·25
V. 659	493	324,887	43·0	Oxide	3·6	14·92	39·1	1·52	6·88

* See fig. 3, p. 574. † Cost of oil taken at 3d. per gallon.

air regulator to insure only sufficient air to obtain perfect combustion from the 5 cubic feet rate of coal gas, and heating 2½ litres of water, the result was obtained of 595 B.Th.U. gross. By increasing the gas consumption per hour to 7¾ cubic feet, and again regulating the air, 595 units were again obtained—clearly showing that, all other things being equal, the results can be repeated at will on steady gas; but if the air be not properly regulated, a lower result follows.

By substituting Bray's flat-flame jets, as prescribed by the Gas Referees, for the bunsen burner, it was found that it depends on the size of the burner and the pressure of the gas supplied whether or not one obtained concordant results. The sizes of jets employed in the Junkers' instrument are given below. They were fed with the same gas as previously used, maintaining a like volume per hour, which of necessity increased the pressure at the point of ignition.

Two Bray's No. 4 Regulator Burners.
5 cubic feet : 587·3 B.Th.U. = 7·7 per cent. too low.

Two Bray's No. 3 Regulator Burners.
5 cubic feet : 588·4 B.Th.U. = 6·6 per cent. too low.

Two Bray's No. 2 Regulator Burners.
5 cubic feet : 586·0 B.Th.U. = 9·0 per cent. too low.

It is important to mention that there is a great rise in the temperature of the products from flat flames over the use of bunsen flames, which has a beneficial effect on the net value should this be desired. The greater rate of burning the gas by the bunsen burner only elevated the temperature of the products without influencing the B.Th.U. From the above results it is noticed that the particular type of burner seems to have no great, yet some, effect when the gas is burned at the rate of 5 cubic feet per hour. The following tests also show the influence of different rates:—

Two Bray's No. 4 Regulator Burners.
7·25 cubic feet : 592 B.Th.U. = 3 per cent. too low.

Two Bray's No. 3 Regulator Burners.
5·8 cubic feet : 566 B.Th.U. = 29 per cent. too low.

Two Bray's No. 2 Regulator Burners.
5·5 cubic feet : 563 B.Th.U. = 32 per cent. too low.

Clearly these results indicate the necessity of using the non-luminous flame in order to obtain the maximum gross thermal value of town gas. Besides, this is the way most of the gas is used to-day, whether for incandescent lighting, cooking, fires, or engines. The instrument employed should be proof against recording any erratic values of the gas consumed in it. The present Boys calorimeter does not lend itself readily to such use. But blue gas cannot be burned in it; and besides flat-flame burners are not in accordance with modern usage and methods of burning gas, except for lighting and their safe use in geysers, and therefore should be abolished as the standard burner for testing gas for its heating value. The difficulty is to know when the gas is supplied with sufficient air.

Gas undertakings should possess the most suitable apparatus for testing the thermal value of the gas, and the burner employed should be capable of consuming to the greatest advantage in developing the heating value a like volume of any illuminating gas—in fact, any gas. It is also important that the quantity of air for the proper combustion of the gas shall be so regulated that every portion of the flame shall receive a slow, steady, and uniform but ratio-ed supply, so as to evolve the total heat from the gas.

The basis, therefore, is that we get from the gas supplied "the greatest amount of light;" and, having got this, then, its corresponding thermal value is the true one, and one which is not likely to be a burden to gas companies.

It is considered by some that the value of a cubic foot of gas varies, to advantage, by increasing the pressure. This is quite erroneous, but it may have been found because at the lower pressure the gas was not sufficiently supplied with air. It is in the everyday use of commercial gas that both the supplier and user are concerned in seeing that the best is obtained from what is employed in the household; and to this end we must all strive to secure it.

EXPERIMENTS WITH LOW ILLUMINATING POWER GAS.

So much has been said in the past about the inefficiency of low illuminating power gas, that just one series of experiments will be given to show how groundless are such theories. Coal gas of such value that from the Bray No. 7 on No. 5 regulator burner at 5 cubic feet gave 7·59 candles; calorific value gross 532 B.Th.U.; incandescent burner at 3 inches pressure, 20 candles per foot; specific gravity ·3258. Taking water of 60° Fahr. and raising the litre 100° Fahr. by means of a 7-inch diameter copper kettle with the gas consumed at the rate of 10 cubic feet per hour, 287·3 B.Th.U. were utilized, which equals 54 per cent. of the gross value. By using a 12-inch diameter kettle, 298·5 units were utilized, or 56·1 per cent. of the heating value of the gas.

The remaining volume of gas was then reduced in value by stripping with an oily liquid, and the whole was afterwards carefully mixed. Tested by a Bray's flat-flame burner, 4·91 candles, or 35 per cent., reduction was revealed, with a calorific value of 517 B.Th.U. gross, or only 2·8 per cent. less than before treatment. Incandescent, but at 3 inches pressure, 19·2 candles per cubic foot, or 4 per cent. less, and the specific gravity ·3223, or only 1·07 per cent. less. A litre of water heated in the 7-inch kettle by gas at 10 cubic feet per hour showed that 285¼ B.Th.U. were utilized, or 55·2 per cent. efficiency; while by the 12-inch kettle 292¾ units, or 56·6 per cent. of the gross value, were utilized.

Percentages are somewhat misleading; but the water-heating figures show that there is greater economy commercially by the use of the poorer quality gas to the extent of 1·2 and 0·5 per cent. respectively. Then there is also the beneficial effect on the community, since less air is needed to support or complete the combustion of the lower-quality gas, with a greater certainty of efficient results all round.

These results are not by any means low, but they simply indicate that greater efficiency should be obtained by boiling burners. Higher figures are often claimed by apparatus makers; but our customers seldom obtain such economical results. Of course, the whole of the difference or balance is not lost, whether from lighting or cooking burners, and much of the heat that escapes utilization in the way indicated goes to aid ventilation or warming the apartment. The writer has taken steps to recover some of this loss, and has been successful in obtaining from 2 to 2½ gallons of hot water (for washing up dishes or food purposes) having a temperature of 160° to 200° Fahr. every time the cooker oven is used. This costs nothing, but clearly proves that further economies are possible.

Stripping town gas of its illuminants would never be resorted to by any wise gas manager. It is possible to do so, but not economically; and, if done, it would mean a reduction of 12½ to 13 per cent. of the total heat value.

In these times it behoves us all to be careful and endeavour to get the greatest value out of our raw material so as to sell cheap gas, and, when sold, to help those who use it, by instructing them in the best and most advantageous way possible.

With this end in view, this paper will conclude by giving the results of some experiments carried out on blue gas carburetted with oil, to show that there is at least some hope in the future for cheaper carburetted water gas. In the present-day practice of making this gas there is great waste of enrichment; and to remedy this should be one of our objects in the immediate future. The figures are worthy of some study, for they have taught and enlightened the writer.

DISCUSSION.

The PRESIDENT (Mr. David Vass, of Perth) said that Mr. Grafton had brought to their notice a subject which would be more or less before them all in the near future—the question of testing their town gas. They were in most cases to some extent doing it at present; but they were not working under any standard in this respect. Already several English companies had adopted a standard; but this standard, he thought, had been on rather big lines, in respect that they had been given a maximum and a minimum. Like Mr. Grafton, he thought there was a danger in this, because, if there was only one line drawn as to where a gas company was to register its minimum and its maximum, then every company would try to get as near the line as possible. He foresaw a difficulty and a danger in this.

Mr. A. MASTERTON (Edinburgh) said the manner in which Mr. Grafton had treated this subject opened up a question which, no doubt, would lead to a great amount of controversy; but he thought it would terminate in advantage to the gas industry. It seemed to him no time should be lost in having the experiments

repeated, and substantiated on various mixtures of gases, and in as many different works as was possible. He was inclined to think that the result of Mr. Grafton's investigations would raise the nominal value of the gas without a corresponding benefit to the user; and his own experience was that the class of consumer to whom Mr. Grafton referred as being mean as regards measure, and who would be rather difficult to satisfy, formed a large proportion of one's actual customers. Then again it ought not to be overlooked that the calorific value of gas did not depend upon its illuminating power but on its composition; and two gases of the same illuminating power might differ widely in their calorific value. This was demonstrated by Mr. Grafton's second table, in which the carburetted water gas, the mixed gases, and the coal gas were compared; and, of course, these differences were often more pronounced when the illuminating power had been taken by what was termed the Grafton regulator burner. Further, the practice of stating calorific value in thermal units of any kind was misleading, because the candle and the British thermal unit were not in direct ratio. This was readily understood when it was remembered that the bulk of the gas supplied was composed of non-illuminants and a very small percentage of illuminants. Then, again, they had to bear in mind that the standard test for illuminating power was the No. 2 "Metropolitan" burner. It was by this burner that the calorific standard had been decided. Before any alteration could be made on the standard calorific value, another burner would be necessary. There were no other points in the paper which required touching upon; but he could not help thinking, as the paper was being read, that Parliamentary Committees would do well to secure Mr. Grafton's services when dealing with the question of gas standards.

The PRESIDENT observed that it seemed to him the time would come, and that at no very distant date, when the question of illuminating power would be set aside altogether. As a matter of fact, he did not see why it should be dragged in at all. If a calorific standard was set up, what relation had it to the lighting value of the gas? Mr. Grafton, in his paper, pointed out very clearly that they could get almost anything in the way of illuminating power, and yet have a fairly steady calorific effect. If this was the case, it mixed up two things which ought not to be on the same lines. It was the public who required to be satisfied in these matters; and if they were satisfied, it was everything. He thought that adding to the price charged to 90 per cent. of the consumers so as to please the other 10 per cent. in giving them illuminating power, was asking too much, and was a wrong policy altogether. He would be glad to hear Mr. Grafton's views upon this point.

Mr. GRAFTON, in reply, said it was the loss of even 1 per cent. of their consumers they had to look carefully into. They ought to make sure that they secured the greatest value out of their raw material, and that no foreign matter was introduced which would interfere with a good light to the consumers. It was to the interest of the gas profession to see, not that the 90 per cent. referred to by the President got poorer gas, but cheaper gas. In his demonstration that day, and in the paper itself, he had endeavoured to prove that from the No. 2 "Metropolitan" burner they were not getting the greatest amount of light provided for by their Acts of Parliament. With regard to the observations made by Mr. Masterton, he did not quite agree with this gentleman that illuminating power was different from B.Th.U. power. What they wanted —and this was what he aimed at in his paper—was the simplest test that would determine the maximum value. He was very grateful indeed to Mr. Masterton for the personal compliment he had paid him. His only regret was that the paper had not been in their hands for some time prior to the meeting, so that the discussion might have been more complete.

THE JOHNSON DIRECT-JET BLAST LAMP.

An objection not unfrequently raised to gas-fires by certain consumers is the slight noise caused by the burners. This objection can now, it is claimed, be disposed of by the use of the Johnson direct-jet blast lamp, manufactured by the Johnson Gas Appliance Company, of Cedar Rapids, Iowa, U.S.A. It is shown in the accompanying illustration, and attention may be called to the features in which its construction differs from that of the blast-lamps now on the market. Many of these are adjusted to varying conditions of gas pressure by a needle valve, which partially closes the orifice, decreasing the velocity of the gas, and changing its shape and alignment. The Johnson lamp is adjusted by opening and closing the orifice itself; thus securing the highest possible velocity to the gas, and directing it so as to obtain the most perfect mixture with the air. The air-chamber is formed to secure perfect combustion, the full heat value of the gas is obtained, and a flame of high temperature is produced without the use of air pumps or bellows. By turning the regulating screw S, the cap C is moved up or down upon the burner tip B, the segments of which are elastic, so that the orifice O is adjusted to the proper size. This will permit the gas to issue without retarding its velocity, adapt the burner to varying conditions of gas supply, and secure the proper proportion of gas and air to produce a flame of maximum intensity. The ordinary bunsen flame has at the centre a cold cone ranging in temperature from 300° to 520° Fahr., while the hottest part of the flame is 1520° to 1570° Fahr. The Johnson burner gives a temperature of 2250° Fahr. and upwards in the hottest portion of the flame without the cold central cone, and the coolest portion of the flame is many degrees hotter than the hottest part of the bunsen flame. It is claimed for this burner that it gives a hotter flame than many others using 50 per cent. more gas, so that it is very economical in operation. The No. 2 burner uses only 10 cubic feet of gas per hour. It starts at the touch of the match, attains its maximum temperature at once, and burns with an intensely blue flame free from deposits. The lamp is fitted with a pilot-light, so that it can be turned on and off without relighting. The burner can be easily raised and lowered, and turned to any angle, or even removed from the stand and used as a hand torch.

Reference has already been made to the claim made for the Johnson burner that by its use a noiseless gas-fire will no longer be difficult to obtain. Another is that there is an entire absence of smell when these burners are used to heat cold surfaces. Consequently fears of "gas poisoning" will no longer be inimical to the use of geysers; while from laundry irons the heat required will be obtainable with freedom from smell.

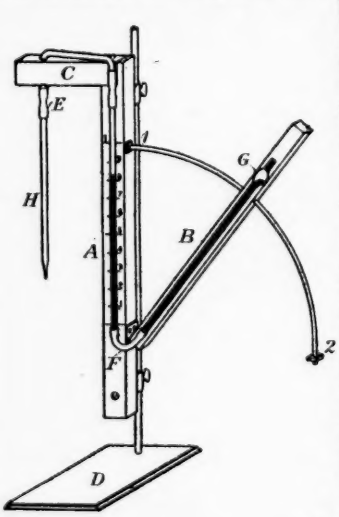
The British agents for the burner are Messrs. Edwin A. Mansfield and Co., of New Brighton, Cheshire, who have received favourable opinions of it from several gentlemen connected with the gas industry to whom it has been shown.

MEASUREMENT OF FLUIDS.

The "Pipettometer."

The "Journal of the American Chemical Society" recently contained an illustrated description of a new piece of apparatus for measuring precise quantities of fluids without the use of graduated pipettes. It consists essentially of an upright graduated glass tube with an upper side arm, to which, by means of a piece of rubber tubing, ungraduated glass pipettes may be readily attached. At the lower end of the graduated tube, another tube is attached by means of a flexible rubber joint. This tube has a bulb at the outer end, and is so arranged that the bulb end can be readily raised or lowered. The upright tube and the movable arm with bulb are partially filled with mercury. The whole apparatus is supported on a wooden or metal frame so attached to a ring-stand that its height can be varied. By moving the bulb up or down, the height of the mercury column in the graduated upright can be raised or lowered. When the mercury is lowered in this tube, the pipette draws up the fluid into which its tip is immersed, and when it is raised the fluid is forced out. The quantity of fluid taken up or discharged is measured by reading the position of the mercury in the graduated upright.

The construction of the apparatus and the method of using it will be understood by reference to the accompanying diagram. A is the support, with its short arm C on the top and left, while B is the longer arm hinged at the bottom. The whole is supported on a ring-stand D, to which it is held by the screw clamps as shown. Mounted on this frame is the bent glass tube E, with a flexible joint at F and a bulb at G. When the arm B is moved up to position 1, the mercury stands at 1·0, and when it is lowered to 2 the mercury stands at 0. A graduated pipette H is attached at E and the arm B is raised to 1. A vessel containing the fluid to be drawn into it is brought to the point of the pipette, and the arm B lowered to 2. In this way the fluid is drawn into the pipette H. It can then be discharged in whole or in part by slowly raising the arm B; the amount discharged being indicated on the scale. The graduations on the scale must be carefully made. This can be done by drawing water into the pipette H and then discharging it and weighing it on a fine balance. In this way the 0·5 and 1 c.c. points can be determined. It will be accurate enough for ordinary work to mark off the intervening points.



The glass tube can easily be replaced by a very small one (in which case hundredths of a cubic centimetre can be easily measured), or it can be replaced by tubes of greater capacity—an arrangement which makes it convenient for measuring amounts of 10 c.c. or more.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

A Study in Contrasts—A Suggestion to Mr. Hugo Hirst.

SIR,—*Apropos* of our recent articles concerning the withholding by the Travancore Minerals Company of the raw material for the mantle industry, it would doubtless be of interest to your readers to know that the presiding genius of the Travancore Minerals Company and of the General Electric Company is one—Mr. Hugo Hirst. Mr. Hirst as a business man is probably without equal, but the idea of Mr. Hirst as a patriot of any country other than the "Fatherland" is, when one considers the action of his Companies with regard to our raw materials, ludicrous.

Witness Mr. Hirst in an interview published in the "Daily Express" of the 20th ult., urging that British manufacturers of every kind, after they fulfil their duty in supporting the British Army and Navy, should strain every nerve to take Germany's place in the British home markets. "Provided we are willing to work as hard as the Germans did, and to sink capital and secure financial and public support," said Mr. Hirst, "I think there is little doubt that we can replace a large proportion of German imports here at home. This should be our first concentrated care."

We should like to suggest that, in order to be logical, Mr. Hirst should see to it that the two Companies under his control should make the first step in replacing that small proportion of German imports manufactured from the monazite sand from Travancore.

For the VOELKER LIGHTING CORPORATION, LTD.,
THOMAS D. ASTEN, Chairman.

Garratt Lane, Wandsworth, S.W., Sept. 5, 1914.

Thorium Nitrate.

SIR,—In the advertisement pages of your current issue there appears an anonymous insult to the South Metropolitan Gas Company, which must have created indignation in all unbiassed minds.

It is nothing short of a scandal that such unworthy reflections should be cast on the endeavours of one of the premier gas companies, to save the gas industry from the damage which would be done to it if a scarcity of mantles or an exorbitant charge for them obtained.

I am convinced that the general opinion in the gas industry is to the effect that the foresight of the past and present administration of the South Metropolitan Gas Company in providing a stock of thorium nitrate is worthy of all praise; while the suggestion that an attempt is being made to enrich the Company at the expense of the gas industry generally is too absurd to call forth comment.

The novel practice of using the advertisement columns of a Technical Journal for the throwing of cheap sneers from a hidden source is one which I hope will not be repeated.

A. MORTON FYFFE.

Nelson Corporation Gas Department, Sept. 5, 1914.

[We quite agree with the view of our correspondent that "the general opinion of the gas industry is to the effect that the foresight of the past and present administration of the South Metropolitan Gas Company in providing a stock of thorium nitrate is worthy of all praise;" and we are pleased to publish the recognition from an independent member of the gas profession, because, forsooth, there has been very little such recognition publicly made since the flow of thorium nitrate to this country was stemmed by current events. But we do not imagine that the South Metropolitan Company, although deserving it, really desire any sympathy over the attempt to discount any credit that attaches to their service and intervention (through the prevision which enabled them to intervene) in the defence of the interests of the gas industry at the present time. The attempt has the same effect upon them as rain has on the back of a duck. The advertisement to which Mr. Morton Fyffe particularly directs attention had, it appears to us, its intention destroyed by the advertisement published in last week's issue on p. 531, which advertisement shows how heavily the South Metropolitan Company had to pay for the provision of a fortification which comes to the general defence so fortunately in an emergency for which the industry itself had not legislated. The lesson we hope will go home and have effect. As to the anonymity of the advertisement referred to by our correspondent and its "hidden source," it reached us from responsible men in one section of the gas industry. There is not the slightest question in our minds that if asked, the Chairman of the South Metropolitan Company would not admit that he would have to seek far for, or have any difficulty in locating, the "hidden source."—ED. J.G.L.]

Prices under Tar Contracts.

SIR,—In the article, on tar prices, appearing in your issue of Sept. 1, p. 526, you ask for the views and suggestions of your readers.

The suggestion that tar distillers should pay £1 per ton of tar, on account, for all deliveries up to the time when shipping again begins, will meet the case very well, provided the war terminates at an early date. Mr. Asquith told us in his speech at the Guildhall that we might expect a protracted war; and in consideration of this, it would be wise for tar producers and tar distillers to act with foresight, and make such provision as will ensure gas-works being kept clear of tar stocks.

Many co-workers of our two industries have rallied to the Colours, and are serving this great country of ours with their lives. Those who remain must serve unselfishly in every other possible direction.

Tar distillers should do all in their power, by removing and working tar, paying carriage, and financing the process of tar distillation, placing their full storage capacity at the disposal of the tar producers. In return, the tar producers should defer payment until such time as products become realizable.

With generous consideration on both sides, it will be an easy matter to arrive at an equitable price when normal conditions again prevail.

For BROTHERTON AND CO., LTD.
CHAS. F. RATCLIFFE, Director.

Leeds, Sept. 5, 1914.

British Mantles and Prices.

SIR,—We must first thank you for inserting our letter of the 28th ult., and are very pleased it has attracted your personal notice to elicit from you some comments, which we cannot pass over without replying thereto.

While having full regard for the superior knowledge ruling in London—after all, with every possible opportunity of obtaining information ahead of Manchester folk—we should like to be informed through your columns where you get your information from, that 40 per cent. of the incandescent mantles consumed in this country are made here. If you said 10 per cent. it would be nearer the mark; but 40 per cent., with all due deference, will mislead your readers. Not that it can make any material difference at this stage; but let us not hoodwink each other. Let us get at facts with every possible relation to truth. We quite agree with you that we should not rest until the mantle makers in this country make the full 100 per cent.

It was only on Friday last that the writer, on behalf of his Company, attended a meeting of manufacturers and merchants under the auspices of the Column Club, held at the Grand Hotel, Manchester, to devise means of retaining the trade which the unfortunate international war has compelled Germany and Austria to hand over to us gratuitously. Three grand principles were suggested, and unanimously approved of by the large assembly—the proceedings of which, by the way, were reported throughout the Press.

The first was that a campaign should be initiated by the whole of the Press in this country to induce banking institutions to give a helping hand in the introduction of new enterprises, and more readily recognize the virtues of well-conducted commercial men engaged in manufacturing, for the purpose of retaining the business which has been suddenly thrown at them to deal with.

The second principle was that the financiers of this country should immediately move in promoting industries which have in the past wholly or principally been in the hands of the Austrians or the Germans.

The third principle was that manufacturers already operating in this country should move heaven and earth to extend their operations with the aid of the financier and the banker, in undertaking the manufacture of articles which may be foreign to them. By this means, the three classes of men referred to will directly be the means of alleviating the distress unfortunately so prevalent, as we contend that there is enough demand for home consumption, now that foreign competition is completely cut off, to find employment for every inhabitant in these isles. There can be no question at all about this. One has only to glance at the Board of Trade returns of imports.

Of course, these statements have no direct bearing on the incandescent trade, which is, after all, a new industry in this country, and being a German invention, Germany may naturally claim to be the home of the incandescent light industry. If any scheme or movement is initiated, we shall begin to agree with you that there be no need for the British mantle makers to shut-down; but unless they do adopt some such measure, you can take it from us that, for the want of one material or another, gas-mantle makers as well as factors will be compelled to shut-down. One has only to glance through the copies of the trade papers to find the absence of the usually important trade announcements which flood their pages during this period of the year, under normal conditions.

Is the Editor aware that there is not the remotest opportunity in the near future of supplying the needs of this country with incandescent mantles? If mantles are obtained, which is quite impossible of expectation, unless Uncle Sam comes to the assistance of England, what about glassware? Is it possible to use an incandescent light upon a street-lamp without a globe? There are no glass-works in this country to-day that have been successful in introducing the required glass; and the valued expression by the present King, some years ago, when Prince of Wales, which commenced with the words: "Wake-up, England!" had never produced a better application to the present situation than can possibly be imagined.

If the wealthier classes of this country would only assist industry, we should never need to fear foreign commercial invasion again. It is through lack of support from the classes of people enumerated above to fill the wide gap in the industrial conditions of this country, that foreigners have stepped in, and succeeded in finding employment by the introduction of their commerce in trades too numerous to mention—the incandescent being but one of the many insignificant lines of business. Let us wake up; we have been slumbering long enough.

For "PIFCO" LIMITED,
J. WEBBER.

Manchester, Sept. 2, 1914.

[There is very little in the foregoing letter to which there is any call for reply on our part. "Pifco Limited" have obtained a couple of very good advertisements without payment; and they must now be content. We should not complain of the free publicity if their letters had added to the sum of human knowledge, or had done anything to advance the interests of the gas industry or any other beneficial cause. Their communications do not appear to have served any good purpose other than—if that can be called a "good purpose"—to have brought into prominence "Pifco Limited." From the present letter as it was

originally sent to us, two passages have been deleted. Our correspondents ought to have known better than to suppose that they could use the "Correspondence" columns of the "JOURNAL" for the purpose of making a covert assault upon another trading firm in the gas industry (which is not cricket), or to use these columns as a vehicle for a purely trade announcement, the proper place for which is the advertisement columns, with due recompense to us for the accommodation and the publicity. Turning to the letter, we will only refer to two or three points. Our correspondents ask whence we obtained our information that approximately 40 per cent. of the incandescent mantles consumed in this country are made here; and succeeding the question is the observation: "If you said 10 per cent. it would be nearer the mark." We really cannot accept a firm who last week stated that "our business is composed of imported goods" as an authority concerning the quantity of home manufactured mantles. Mr. Charles Carpenter, D.Sc., from the data at his command, estimates the home production at 25 per cent. of the total consumption; two authorities on home mantle manufacture place the figure at approximately 40 per cent.; another at upwards of 30 per cent.; and still another who knows well the mantle factories of this country, their productive capacity, and the markets, states that the annual output last year was, according to his estimates, from 40 to 45 millions. If we strike a mean, the man who said upwards of 30 per cent. and the one who puts the total at 40 to 45 millions, are about correct. Last year the value of the incandescent gas-mantles imported into the country, according to the Board of Trade returns (and not statistics issued by Germany) was about £302,000. Taking the round figure of 10s. per gross, this value represents close upon 87 million mantles, and 43 million home-produced mantles would make the total 130 millions—so that the estimated number of home-produced mantles represents upwards of 30 per cent. Upon the various figures that have been obtained, there is confidence in dismissing the figure of a firm one of whose objects appears to be to belittle British mantle manufacturers, with whom the firm, on their own confession, have hitherto done little or no business. "Is the Editor aware," asks our correspondents, "that there is not the *remotest* opportunity in the *near* future of supplying the needs of this country with incandescent mantles." There is no need for alarm as to the near future; and we have sufficient reliance in the resources of this country to know that, if buyers and manufacturers will work together, what in industry and trading Germany has done England can do. The final words of our correspondents' letter are: "Let us wake up; we have been slumbering long enough." These are significant words when placed alongside those that appeared in their letter last week: "Our business is composed of imported goods." They spoke, too, last week of the "anti-foreign policy" that they fancied they detected in some of our articles, and which detection struck them with amazement. Reading the last paragraph of the letter above, they have manifestly quickly recovered from their amazement.—ED. J.G.L.]

Gas Companies and the War.

SIR,—The present critical condition of our country has induced many employers to, in every possible way, assist those of their workmen capable of bearing arms to join one branch or another of His Majesty's Forces.

Thinking it may interest your readers, I am enclosing herewith an announcement which has been adopted by some of the companies with which the writer is connected. The result, represented by the additional number of men who by way of response have offered their services to their country, has been very gratifying.

Sept. 4, 1914. OFFICIAL.

[ENCLOSURE.]

THE WAR.

The Company have arranged to make the following allowances to Reservists and Territorials and to Recruits to His Majesty's services.

The wives of those absent on active service will receive half the pay of their husbands up to a maximum of 15s. per week, and an additional allowance of 1s. 6d. per week for each child under the age of 15 years who is wholly and directly dependent upon the mother.

Aged parents or dependents or motherless children of men on active service will receive an allowance consistent with the foregoing statement, which will be adjusted to the particular requirements of each case.

Upon return from active service, each employee will be reinstated in the position he formerly held with the Company; and all single men upon their return to the Company's employment will receive a cash bonus of not less than £5.

The Company bring to the notice of all single men in their employment between the ages of 19 and 30, who are physically fit for military service and who have not yet volunteered for service with the Forces, the present urgent need of their country.

Those who do not volunteer for service are liable to be immediately called upon to relinquish their employment with the Company, in favour of ex-service men and men too old for active service.

August, 1914. BY ORDER.

Aniline, Benzoic Acid, and Salicylic Acid.

A prominent firm of ammonia and tar distillers write with reference to the article in last week's issue entitled "Some Present Opportunities for British Manufacturers." They say that they are at present manufacturing, among other products, pure benzol, pure toluol, and pure phenol, and are considering the advisability of going forward to the manufacture of aniline, benzoic acid, and salicylic acid. They learn that quantities of these products have been regularly imported into this country; and they are anxious to get the very latest information with regard to the manufacture, &c. Possibly some of our readers will be inclined to impart the information through the pages of the "JOURNAL," so as to be of use not only to our present correspondents, but to others who may be intending to turn attention in the same direction.

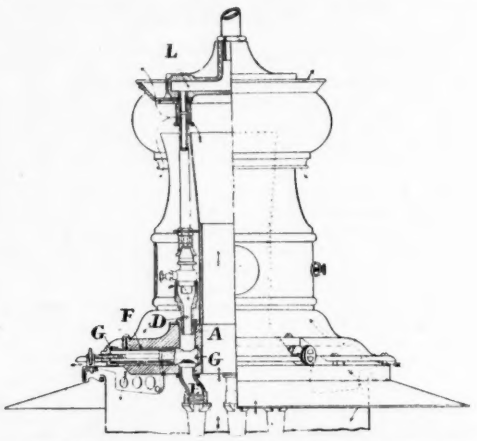
REGISTER OF PATENTS.

Inverted-Burner Gas-Lamps.

WORSFOLD, J., of East Dulwich, S.E., and SMITH, A. J., of Croydon.

No. 17,902; Aug. 6, 1913.

This invention relates to incandescent inverted-burner gas-lamps, with the object of improving the regulation of the combustible mixture.



Worsfold and Smith's Inverted-Burner Gas-Lamp.

A is a trumpet-shaped chimney or base, forming the foundation of the lamp, having bosses on the upper and lower sides respectively. A hole is drilled vertically through the bosses to receive the mixing-tube D at its upper side and on the underside to receive the connection E and burner-nozzle. A horizontal hole F is drilled through the projection formed by the boss-pieces, so as to receive the regulating and mixing device G—described in patent No. 7515 of 1911. This mixing device can be removed for cleaning by loosening the screw by which it is held in position.

The air entering the lamp travels in the direction of the arrows, supplying the primary air to the bunsen tube and the secondary air for supporting combustion, which latter is heated in a chamber formed between the reflector and the base A. The area of the air inlet may be increased or decreased by varying the height of the upper part of the spacing screw provided for the purpose at the side.

An extension piece (having a broad flange at both ends) is fitted to the chimney A, and secured by means of a bushing piece passing through holes in the lower flange, while corresponding holes are provided in the upper flange for attaching the gas supply connections.

In the head of the lamp is a superheater L in the form of a circular hollow chamber, preferably of cast iron or aluminium. On the upper side an inlet is provided for connecting the main gas supply; and on the under side are openings to suit the number of burners to be supplied. This superheater and method of connecting the gas supply is adopted in preference to the usual body with arms radiating from same, as it is said to provide "a method of suitably preheating a larger volume of gas, and, further, the heat absorbed by the chamber is conducted to the metal wind-guard casings, and by this means the supply cock and ball-joint with which the lamp is terminated are protected from excessive heat."

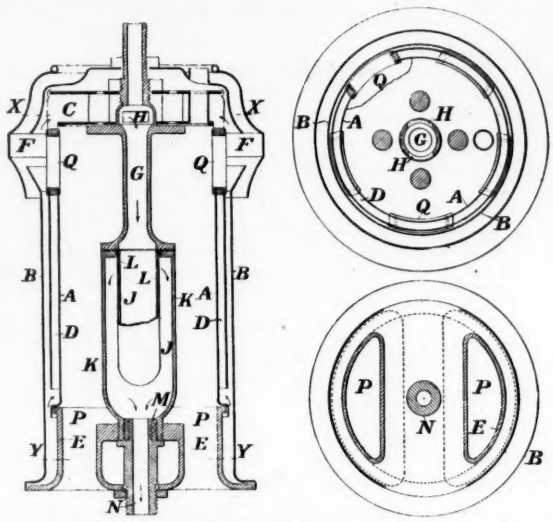
Inverted Incandescent Gas-Lamps.

CHANDLER, D., and SOUTH METROPOLITAN GAS COMPANY, of Old Kent Road, S.E.

No. 18,094; Aug. 8, 1913.

In lighting with inverted incandescent gas-lamps (particularly high-pressure lamps), it is recognized, say the patentees, that "it is most desirable to provide for the heating and thorough mixing of the combustible gas and air and at the same time for the prevention of the overheating of the nozzle or burner proper, which has a great tendency to cause

lighting-back." The present invention therefore is directed to the construction of a lamp wherein the heating of the mixture and the cooling of the nozzle are provided for.



Chandler's (South Metropolitan Gas Company) Inverted Incandescent Gas-Lamp.

An inverted incandescent lamp, embodying the improvements, is given in sectional elevation and transverse sections on the lines X and Y.

The inner case of the lamp A is double walled; B is an outer case. On the summit of the casing A is a closed chamber C, opening into the annular space D within the double walls of the inner casing. The lower end of the inner wall of this casing rests upon the base E, which also supports the outer casing and a canopy or cover F carried by it. G is the Venturi tube attached to the underside of the chamber C, and having an extension passing upwards through the middle of the latter. In the extension are holes H opening into the chamber C. At the lower end of the tube G is attached the heater and atomizer, which comprises two chambers J K, one within the other.

The tube G communicates with the interior of the chamber J, which is closed save for radial holes L communicating with the surrounding chamber. The chamber (open at its lower end) has screwed into it a sleeve or ring of non-conducting material M; and into this ring is screwed the end of the nozzle N. Part of the base E (secured to the outside of the chamber K) forms a passage or air-way around the nozzle N, and extending transversely the entire width of the lamp.

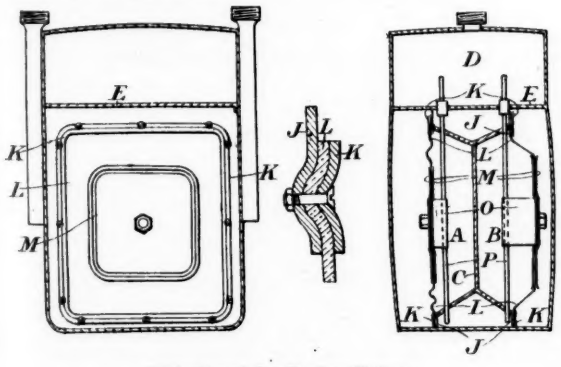
The primary air for the combustible mixture enters the outer casing B through apertures near the bottom, and passes, in the direction of the arrow and up the annular space D, between the walls of the casing A and enters the chamber C. Thence it passes through the holes H into the Venturi tube, where it meets gas entering the tube from an injector [not shown] in the ordinary way. The mixture then passes into the chamber J, and thence, through the atomizing holes L, into the chamber K, whence the burner is reached. The products of combustion pass up inside the casing A through the passages P in the base, warming the primary air in the space D, and find an outlet through holes Q into the canopy F, whence they escape. The wall of the base shields the nozzle N from the heat of the combustion products, and the air-way helps to keep the nozzle cool, as does also the refractory ring M.

Gas-Meters.

HIBBERD, C. E., and GOAD, F. L., of Edinburgh.

No. 25,381; Nov. 6, 1913.

This invention relates to gas-meters with the centre plate formed in section with a central straight portion and forked end portions, as shown in cross sectional elevation, front elevation (with the front cover and the front of the gallery removed), and a detail showing the method of fastening the diaphragm.



Hibberd and Goad's Gas-Meters.

The casing is divided into two measuring chambers A and B (as regards its lower part), by means of a centre plate C and a gallery D, and as regards its upper part by means of a partition E. The centre plate is formed so as to constitute in section a centre straight portion with forked portions at the ends of the straight portion. The centre partition will thus be of dished form, and serve to limit the movement of the diaphragm at one end of its stroke; while the movement of the diaphragm at the other end of its stroke will be limited by the extensibility of the diaphragm itself.

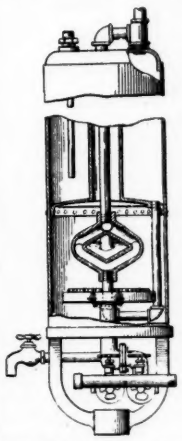
In order to fix the reciprocating diaphragms in their respective chambers, a plate J for each chamber is provided, consisting essentially of a flange or rib outstanding from the four walls of the chamber, and having its centre portion cut away. Between this plate and an annular clamping plate K, of similar shape, the diaphragm L is arranged; the two plates being beaded either with similarly or reversely disposed beadings as described in patent No. 5647 of 1912. The centre part of the diaphragm is clamped as usual between the diaphragm discs M, which may also be beaded as above; the flags O transmitting motion from these discs to the flag rods P, and so to the recording mechanism in the ordinary way.

Gas Water-Heaters.

BASTIAN, W. B., of Chicago, Illinois, U.S.A.

No. 22,061; Sept. 30, 1913. Convention date, Sept. 30, 1912.

This gas water-heater is of the kind in which the heated water is caused to circulate through a system of pipes, and which is provided with a cup-shaped receptacle (termed a "spreader") located adjacent a gas-burner, which heats the water contained within the spreader. The arrangement is such (as shown) that "the water will be in constant circulation, and will be subjected to the maximum amount of heat."



Bastian's Gas Water-Heater.

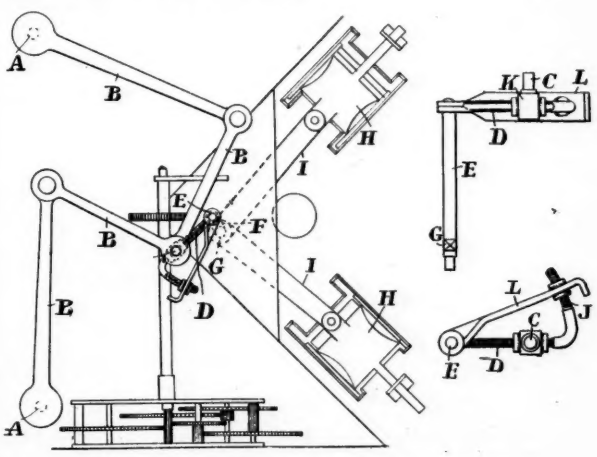
The spreader comprises two horizontal imperforate plates arranged one above the other and spaced apart so as to leave between them a saucer-shaped chamber for the circulation of the water to and from the boiler of the heater; the outer portion of the chamber being in communication with a number of hollow radial branches located above it, and having their inner ends in communication with a water-circulating pipe. The spreader consists of two substantially concavo-convex plates with their concave faces uppermost, as has been previously suggested in connection with water-heaters of the non-circulating type; and the radial branches extend upwards and inwards and come together in a hollow spud which is connected to a circulating pipe extending vertically to the boiler of the heater. The circulating pipe is preferably composed of two vertical branches and a horizontal branch, adapted between them to clamp and adjustably hold the burner of the heater in position. The threaded branches of this pipe are connected as one continuous piece by elbows, and one of the branches passes freely through an opening in the burner, which is engaged at its periphery so that it may be adjustably held in position.

Dry Gas-Meters.

HIBBERD, C. E., of Tooting, S.W., and GOAD, F. L., of Edinburgh.

No. 25,853; Nov. 11, 1913.

This invention relates particularly to dry gas-meters of the kind in which provision is made for angular or circumferential adjustment of the tangent-pin in relation to the crank; the main object being to effect improvements as regards compactness.



Hibberd and Goad's Dry Gas-Meters.

The illustration is a plan of the meter as a whole with the top cover removed. It shows the position of the tangent-pin adjustments in relation to the valve mechanism and other parts (of any suitable type). In the example shown, the flag rods A, operated in the ordinary manner by the movements of the diaphragm in the measuring chambers, are connected by links B to the tangent-pin C, carried by an arm D, mounted upon the vertical crank-shaft E. This crank-shaft is provided with the usual crank F, the pin G of which is operatively

connected to the valves H by the links I. The tangent-pin adjustment shown is one of several described in detail by the patentees.

The arm D, with which the adjusting means are associated, may be mounted loosely on the shaft E, and may comprise a radial length near the axis of the crank-shaft and an outer end portion J, curved to about the arc of a circle struck from the axis K of the crank-shaft as the centre. The tangent-pin C, formed integrally with its boss, is adjustable by locking nuts in any position along the radial portion of the arm which is screwed and flattened on opposite sides as indicated. The outer curved portion, which is also screwed, passes through an aperture in a radial arm L fixed to the shaft; a locking nut being provided on each side of the arm to fix the angular position of the tangent-pin C.

Gas-Producers and their Working.

STEWART, J., of Dennistoun, Glasgow.

No. 21,697; Sept. 26, 1913.

This invention relates to gas-producers designed for the continuous production of tar-free gas from bituminous fuel; and it has for its object improvements in the construction and arrangement of gas-producers of the type described in patent No. 26,858 of 1909 and improvements in the methods of working them "by and through which the production from bituminous fuel of a tar-free gas of reliable quality can be efficiently controlled and be carried on continuously;" also improvements in the arrangement of the producer for the purpose of producing such gas.

Production of Gas for Lighting and Heating Purposes.

VIGNON, L., of Lyon, France.

No. 29,624; Dec. 23, 1913. Convention date, Jan. 2, 1913.

The applicant has previously made known a method for the production of a gas formed principally of hydrogen and methane by passing steam over a mixture of carbonized combustible material (such as coke) and lime heated to a temperature between 600° and 800° C. This temperature was chosen because it is lower than that of decomposition (900° C.) of the carbonate of lime formed in the reaction, and as it was proposed to obtain a pure gas, more particularly one not containing carbonic acid or carbon monoxide.

It has also been proposed to obtain a gas consisting of hydrogen and carbon dioxide by passing steam or water vapour over a mixture of carbonaceous material—such as coke and a hydrate of the alkaline earths—at a temperature below 1000° C., and to separate the carbon dioxide from the hydrogen.

The applicant has discovered, however, that by heating the mixture of carbonized material and lime according to his previous process, to temperatures above 800° C. (say, to 1120° or 1200° C.), the following results are obtained: (1) The speed of the reaction is much greater. (2) The temperature of decomposition of carbonate of lime being exceeded, the carbonic acid formed by this reaction is liberated, the lime remains in a free state and constantly assists the reaction by its whole mass, and the proportion of lime necessary to the reaction can be very considerably reduced for this reason. (3) A gas is produced which contains methane, hydrogen, carbonic acid, and (according to the conditions under which one operates) a proportion of carbon monoxide either small or more or less large.

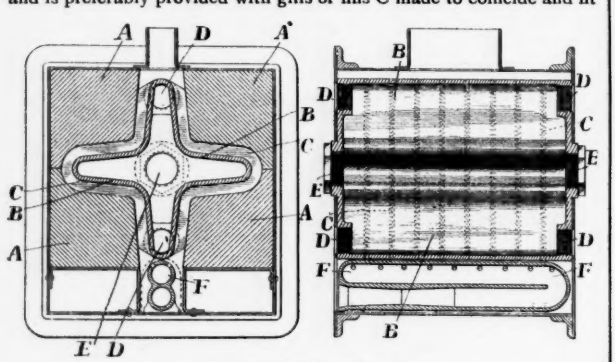
Other details of the proposal are contained in articles that have appeared in the "JOURNAL"—May 12 last, p. 432, and July 7, p. 28.

Water-Heater.

GLOVER, T., of Edmonton, N.

No. 9481; April 16, 1914.

This water-heater consists of a casing in which are positioned fire-blocks A; the two bottom ones being supported on brackets or lugs, while the two top blocks rest on the bottom blocks. The blocks are of the shape shown, and extend from the front to the back of the heater. The water container or heater proper B is cross or star shape, and is preferably provided with gills or fins C made to coincide and fit



Glover's Water-Heater.

inside the fire-bricks A, or the gills on the top and bottom arms may be the same as those on the side arms—*i.e.*, not cut off. The water container is preferably cast in one piece, and has holes D E tapped at each end, for ease in cleaning; and the flow and return pipes are connected to the holes D at either or both ends.

At the top of the casing is a chimney, and at the bottom the source of heat—preferably a gas-burner. The ends of the casing are closed by plates in which are holes corresponding to the holes in the water container and gas-burner.

By making the water container star shaped, and with gills fitting fairly close to the fire-blocks, the heat rising from the burner must circulate around the arms of the container to reach the top and chimney, and in so doing imparts its heat to the water container and fire-blocks.

MISCELLANEOUS NEWS.

OLDBURY GAS UNDERTAKING.

New Manager Appointed.

At a Meeting of the Oldbury District Council on Friday, the Gas Committee recommended that Mr. Carder, of Bath, be appointed Gas Engineer at a salary of £250 per annum. It was explained that Mr. Carder was formerly at Cardiff, and he received his training under Mr. S. O. Stephenson, the Gas Engineer of Tipton.

Mr. WILSON, M.P., who spoke of the illness of Mr. Cooke, their Gas Engineer, said it had been necessary to take this step owing to the serious nature of his complaint. He referred to the long and faithful services of Mr. Cooke, and said they all appreciated the splendid work he had done for the undertaking.

Mr. BEECH inquired who was the Manager of the gas-works at the present time. [A Voice: "Mr. Cooke."] He understood that Mr. Cooke had not been dismissed, neither had he resigned his position.

Mr. WILSON said in the last few weeks Mr. Cooke had not been in a condition either to resign or take any other action. The Committee had, however, taken the step of continuing Mr. Cooke's appointment for three months, at a salary of £200 per annum.

The recommendation was approved.

It was reported that the Committee had received from Mr. J. Ferguson Bell a highly satisfactory report on the gasholder, and had forwarded it to the Local Government Board. An agreement with the Rowley Regis and Blackheath Gas Company for the supply of gas to the Cakemore district was sealed by the Committee.

REVISION OF GAS PRICES AT LEEDS.

New Scale Adopted.

In the "JOURNAL" for Sept, 1 (p. 525), we gave the terms of a resolution, to be submitted to the Leeds Town Council at their meeting last Wednesday, sanctioning a revision in the scale of charges for gas. It stood in the name of Alderman Penrose-Green, the Chairman of the Gas Committee, who, in moving its adoption, said the new scale would not apply to prepayment meters. The reductions were not quite so drastic as the Gas Committee would have liked; but parliamentary powers would be necessary before there could be any further concessions. Certainly they must be in a position to reduce the charge to large consumers, because there was evidence to show that these were adopting means to get their light and power from other sources. The standing powers which the Committee had to meet before a penny could be obtained for the relief of rates amounted to £87,000 per annum, so it behoved them to get as wide a sale as possible.

Mr. J. Clarke, in seconding the motion, said many firms were resorting to suction-gas plant; and it was vital to the gas undertaking that this tendency should be arrested.

Alderman Thaxton moved that the resolution be referred back. He said he thought it was time that some consideration was given to the poorer classes of the city. These people paid by instalments for gas because they did not want large bills; but the Corporation gave them no encouragement. They collected £2000 a week in connection with the prepayment meters. At the same time the other people who used gas with the ordinary meters had a three months' interval before paying their money down, were granted another month in which to pay their bills, and then had 5 per cent. discount; but the people who were paying cash had to pay 3d. per 1000 more than the others.

Alderman Ratcliffe said that prior to the municipal strike the Gas Committee had a scheme whereby all users of gas would have had a reduction in price. The Committee were facing a deficiency of no less than £10,000 or £12,000 already. The proposed reduction would mean possibly £3000 more, and the suggestion of Alderman Thaxton would lift it well on towards £20,000. The consumption of gas had already been, on an average, a million cubic feet down every day since the strike. Having referred to threats made by large consumers not to continue using gas unless something were done on the lines proposed, the speaker said the Gas Committee were out to reduce the price of gas, but they would never do it unless they took some steps to retain the people who were using large quantities.

On being put to the vote the motion was carried.

BURNLEY'S VERTICAL RETORTS.

The Working of the Woodall-Duckham Installation.

Mr. J. P. Leather, the Gas Engineer to the Burnley Corporation, has presented the following report on the working of the Woodall-Duckham vertical retorts in his town.

When recommending the Gas Committee to adopt Woodall-Duckham vertical retorts, in a report presented to the Committee in 1908, I outlined under nine heads the advantages to be expected, and also gave an estimate of the comparative cost of making gas by vertical and inclined retorts. I propose to review the several points in order, in the light of information given to the Committee at the last meeting.

Increased Make per Ton.—Before the introduction of vertical retorts, our greatest make per ton had been 10,539 cubic feet. On the recent working of these retorts, we have realized 12,850 cubic feet per ton.

Improved Quality of Tar.—The tar from the vertical retorts, according to a number of tests we have made, contains a smaller quantity of naphthalene and "free carbon." It seems, however, doubtful whether the general character of the tar is sufficiently altered to enable a distinctly higher value to be put upon it.

Increased Yield of Ammonia of about 25 per cent.—It seems probable that

this claim cannot be substantiated. Our average quantity of sulphate of ammonia remains the same as in previous years.

Improved Quality of Coke.—The coke is undoubtedly better for most purposes. The abolition of the slaking of red-hot coke by water renders it free from moisture. As a fuel it therefore yields a higher heat value.

Absence of Trouble from Stopped Pipes and Pitched-up Hydraulics.—We have had considerable trouble until recently with pitch in the foul main. This trouble has, however, now been overcome.

Increased Make of Gas per Retort and in Proportion to Ground Space Occupied.—This claim is fully justified. The area of the half of the retort-house now occupied by vertical retorts is 5668 square feet, which works out at 4·4 square feet per 1000 cubic feet per day. In the inclined house, where the retort-benches are much too near to one another for the comfort of the men, the maximum make is 2,000,000 cubic feet per day in an area of 10,494 square feet, or 5·2 square feet per 1000 cubic feet per day. Further extensions of vertical retorts in the new retort-house would result in a much greater make per qsuare foot than at present.

Absence of Dust and Smoke, and therefore Better Conditions for Workmen.—This is realized because coke is not drawn from the retorts in a red-hot condition. There is, therefore, no need for slaking with water, with its concomitant production of steam and unpleasantness.

Reduction in Heavy Labour.—This is self-evident.

Reduced Cost of Maintenance.—The first retorts have not had a long life; but there is every reason to expect the realization of this claim in the future.

Cost of Producing 1,300,000 *Cubic Feet per day with Inclines*—108 *Retorts.*

123 tons of coal		£91	4 5
Wages of stokers		5	16 9
,, pipe-jumpers		0	13 3
,, coke-wheelers		2	4 3
		£99	18 8
Less residuals—			
65 tons of coke	£32 10 0		
161 cwt. of tar	12 13 6		
29 cwt. of sulphate of ammonia	11 12 0		
		56	15 6
		£43	3 2

With Verticals—18 *Retorts.*

102 tons of coal		£75	13 0
Wages of stokers		2	11 9
,, coke-wheelers		2	4 3
		£80	9 0
Less residuals—			
56 tons of coke	£28 0 0		
132 cwt. of tar	10 7 10		
23 cwt. of sulphate of ammonia	9 4 0		
		47	11 10
		£32	17 2

This shows a saving of more than £10 per day on the above quantity of gas.

ILFORD GAS COMPANY.

The Ordinary Half-Yearly Meeting of this Company was held last Tuesday—Mr. WILLIAM ASHMOLE (the Chairman) presiding.

The SECRETARY (Mr. G. H. S. Iorns) read the notice convening the meeting; and the Directors' report and statement of accounts for the six months to June 30 were taken as read. The report stated that the volume of gas sold showed the satisfactory increase of 5·03 per cent. over the corresponding period of last year. The balance of the profit and loss account available for dividend was £29,912; the corresponding amount for last year being £27,903. The price of gas having been reduced by 2d. per 1000 cubic feet during the whole of the half year, the proprietors were, under the operation of the sliding-scale, entitled to an additional dividend of 2s. 6d. per cent. for this period; and the Directors recommended the payment of a dividend for the half year at the rate of £7 17s. 6d. per cent. per annum on the "A" and "C" stocks, and £6 7s. 6d. per cent. per annum on the "B" stock (less income-tax). The payments would amount to £7255, and leave £22,657 to be carried forward. The Directors had entered into more favourable contracts for coal and oil for the ensuing twelve months.

The CHAIRMAN, in moving the adoption of the report and accounts, said the cost of coal (which included dues, carriage, unloading, and all expenses of depositing same on the works) amounted to £15,195; and the quantity of coal carbonized during the half year was 14,902 tons, as compared with 15,325 tons for the corresponding half of last year. Therefore they had carbonized 423 tons less, though the expenditure was greater by £2130. Oil used in the manufacture of carburetted water gas also showed an increase of £569. These two items constituted the major portion of the increased expenditure on manufacture of gas. Contracts for coal until September, 1915, had been made at a good average reduction. With regard to oil, they had entered into a new contract up to June, 1915; the price being a favourable one as compared with the figures which had been ruling during the past year or two. These reductions in prices would have a considerable effect on the next two balance-sheets, provided the Company could only maintain their contracts during the present troublesome times. Respecting the sale of gas, notwithstanding the reduction made in the price, the increase in consumption enabled the Company to show a revenue of £29,853, which was only £228 less than in the June balance-sheet of last year. The returns from the rental of meters, stoves, fires, &c., were exceedingly good; the amount received in each case being higher. As to residual products, these show a very marked decrease, though the average price received for their coke was much higher than many of the companies in their neighbourhood had been getting. This was owing to the fact that the Company had a good local trade, and also to the fact that they made a first-class coke, and one which was fairly uniform in quality. With some customers this counted for a good deal. They had increased their consumers during the half year by 213; the total number now being 15,378, as against 15,165 at the end of December, 1913. In the same period there had been fixed 249 cookers, 122 fires, and 41 geysers. These figures did not represent changes from one article to another of the same kind, but the actual net increases in these appliances. The Ilford Urban District Council, as suppliers of electric current in the Company's district, had, in the opinion of the Directors, exceeded their powers in the conduct of their undertaking. As ratepayers, the Company, acting upon the best legal advice, had obtained the Attorney General's fiat to issue a writ. The trial of the action was expected to take place early in the Michaelmas Law Sittings. The Inland Revenue Authorities had asked companies who had deducted income-tax at a rate other than the rate now settled—that is 1s. 3d. as from April last—to refer to the matter in general meeting, stating that the correction would be made at the next payment of dividends and interest. The tax on dividends would, of course, be correct—1s. 2⅛d. (three months at 1s. 2d., and three months at 1s. 3d.); but on the debenture interest paid on July 1 last the tax was deducted at 1s. 3d. (three months at 1s. 2d. and three months at 1s. 4d.). To adjust this tax, in January next ¼d. per pound would be deducted from the rate then current.

The report was adopted, and the dividends recommended were agreed to.

The CHAIRMAN remarked that a great many gas companies had subscribed very handsome sums to the National Relief Fund. The Directors thought if the Ilford Gas Company contributed 200 guineas it would be a good donation.

After a short discussion, it was agreed to leave the matter in the hands of the Directors.

Votes of thanks to the Chairman and Directors, and the Engineer (Mr. W. B. Farquhar) and other officers, and employees, concluded the proceedings.

HASTINGS AND ST. LEONARDS GAS COMPANY.

The Half-Yearly General Meeting of this Company was held last Thursday—Dr. G. G. GRAY, J.P., in the chair.

The CHAIRMAN, in moving the adoption of the report, already noticed in the "JOURNAL" [*ante*, p. 530], referred to the present very serious condition of national affairs, and stated that sixteen of the Company's men were with or were joining the Forces; and Mr. Botley, the Engineer and General Manager, with the kind assistance of Mrs. Botley, was looking after the requirements of the wives and families and other dependents of those who had been called away, and whose places would be kept open for them. The Board wished him to express their appreciation of these services. Turning to the working, the Chairman referred to the difficulty which the Company had experienced in regard to the price of coal and its transport. They had a supply to last them eight-and-a-half weeks, and they had enough in transit for another week and a half. The past half year, not affected by the war, had its own troubles in the abnormally high price of coal and the falling off in receipts from residuals. Bearing this in mind, the results were satisfactory, and, indeed, beyond anticipation. This was due, to some extent, to the increase in the quantity of gas sold, but more to economy by which upwards of 13,000 cubic feet of gas had been obtained from each ton of coal. This was a fine result. There had been an increase in private lighting; but against this they had a decrease in public lamps in consequence of still further conversion to electricity. There was a considerable increase of meters and stoves. On the expenditure side of the accounts there was an advance of practically £2000 under the heading of fuel; but in spite of the war they would benefit, to some extent, by these contracts. The profit for the half year amounted to £11,543.

Mr. A. W. OKE, in seconding the motion, referred to the fact that this is the diamond jubilee of the undertaking, and said it must be very satisfactory to all that just before the outbreak of war the Company was in a strong position, able to meet everything necessary. This was due largely to the policy of the Board and their able management in selling gas at a reasonable figure, and yet at a price which did not jeopardize the position of the stockholders. The record make of gas per ton—the good work in the retort-houses—was one of the secrets of the success of the Company. The stockholders expressed their hearty appreciation of the management.

The report was adopted.

It was then unanimously decided to subscribe 100 guineas to the National Relief Fund.

The retiring Directors and Auditor having been re-elected, a vote of thanks was accorded to the officers and staff.

Mr. BOTLEY, in acknowledging the vote, said he never responded to it without feeling that it was a great honour. It was very helpful when the chief officer could depend not only on the loyalty of those below him, but on the confidence of those above him.

HARROW AND STANMORE GAS COMPANY.

A Satisfactory Record.

The Ordinary Half-Yearly Meeting of this Company was held last Tuesday, at the Holborn Restaurant, High Holborn, W.C.—Mr. A. H. BAYNES, J.P., in the chair.

The SECRETARY and ENGINEER (Mr. J. L. Chapman) read the notice convening the meeting; and the report and accounts were taken as read.

The CHAIRMAN said that, under the powers of the Company's Act of 1913, the whole of the share certificates had been called in. Some of the proprietors had not yet responded; but wherever possible the new converted stock certificates had been issued in exchange. The £10 "A" 10 per cent. standard shares had received £20, and the £10 "C" 7 per cent. standard shares had received £14 of converted stock, bringing all the ordinary capital into one 5 per cent. standard stock, which would have exactly the same benefits as the original shares. The

guaranteed shares and the "B" shares, which were practically preference capital, were both receiving 7 per cent. dividend, and had been together given £14 of stock for the £10 shares, and converted into 5 per cent. preference capital. There was, however, only £21,000 of this stock. Looking at the capital account, there had in the period under review been an expenditure of £1126 on the works; this being for the completion of the retort-house contract, and for a new purifier. On new mains there had been spent £912; all the new services and prepayment house piping having been charged to revenue. New meters and cooking stoves had cost £2391; but as £2143 had been written off for depreciation, the increase in the capital charge was only £248. There had in the half year been 447 cooking-stoves fixed. The capital asset, which twelve months ago stood at 17s. 3d. per 1000 cubic feet of gas sold, had at the same time been reduced to 16s. 2d. During the half year, £8000 of stock had been sold, realizing a premium of £510, as well as £4920 of debenture stock at a discount (being a net amount of £4606. The balance standing to the credit of the capital account amounted to £2439. Turning to the revenue, the receipts for gas for the six months were £24,896, which was an increase of £1425 on the corresponding period of the previous year, notwithstanding the reduction that had taken place in the price of 2d. per 1000 cubic feet. Meter and stove rentals had yielded £3338, which was an increase of £438; but the returns from residuals had decreased by £530. The total receipts for the half year amounted to £34,171, or an increase of £1319 over the same period of the preceding year. Upon the expenditure side of the account, the whole of the benefit of the increased revenue had been practically swallowed up by the increased cost of coal and oil. As far as the other items of expenditure were concerned, it would be noticed that they were about on the same lines as last year, with the exception of new services and prepayment fittings, which had cost £386 more, and had been charged to revenue. Six months ago, £754 was placed to "Suspense account for fires and lamps on hire." Heretofore these had been charged to revenue account; but there were so many fixed now that it was impossible to continue doing this. They had therefore been placed to stock account; and 20 per cent. would be written off each year, until a propitious moment arrived to write them all off from revenue. The result of the half-year's operations was that the profit (£7884) was less than for the corresponding period by £147. To the profit mentioned there had to be added a return of stamp duty of £14, making a total of £7898, to which had to be charged the interest for the use of the reserve fund in the business £71, which made the net revenue for the half year £7827. The dividend recommended would absorb £6608, and the debenture and loan interest £1112, which would leave a balance of £107 to be added to the previous balance, and make a total amount in hand of £5502. The reserve fund now stood at £5911. With regard to the working, the quantity of gas made during the half year was 168,768,000 cubic feet. Of this, 110,256,000 cubic feet was coal gas; and as the amount of coal used was 8995 tons, the make of gas per ton was 12,257 cubic feet. The quantity of oil used in the manufacture of the 58,512,000 cubic feet of carburetted water gas was 102,338 gallons, which worked out at 1·74 gallons per 1000 cubic feet. The increase in the amount of gas sold was 11·33 per cent., as compared with the first half of last year. The percentage of unaccounted-for gas was 4·5; but this was always the best six months in that respect. Over the twelve months to June 30 last, the figure was 6·43 per cent. During the past half year there had been 418 new services laid —172 for ordinary consumers, and 246 for prepayment supplies. The whole of the coal supply up to June 30 next year had been contracted for at 1s. per ton below last year's prices; and there was in stock at the present time over 4000 tons. He concluded by moving the adoption of the report and accounts.

The DEPUTY-CHAIRMAN (Dr. J. W. Lee Glaisher, F.R.S.) seconded the proposition; and it was unanimously agreed to, without discussion.

On the motion of the CHAIRMAN, seconded by Mr. A. F. PHILLIPS, dividends were declared for the half year at the rate of 5½ per cent. per annum on the 5 per cent. ordinary stock, and of 5 per cent. per annum on the 5 per cent. preference stock, both less income-tax.

Mr. SAMUEL CUTLER, in proposing a vote of thanks to the officers, spoke of the good service rendered to the Company by Mr. Chapman —evidence of which, he pointed out, was to be found in the figures just quoted by the Chairman.

Mr. F. R. SMITH seconded, and stated that he had had the pleasure quite recently of going over the works, and could testify to the amount of work done lately in the way of extension and improvement, and to the excellent condition in which everything was kept. He noticed that the works were being guarded by Territorials, who were well looked after by Mr. Chapman.

Mr. CHAPMAN, in acknowledging the vote, remarked that, amid the difficulties by which they were surrounded, it was very pleasant to find that they were able to earn all they needed to pay their usual dividends; and it was also a pleasure to be in a position to distribute them at the present time. They had to thank their bankers for the straightforward manner in which they had been treated by them. All through the trouble, they had not experienced the slightest difficulty. This was how things ought to be.

Mr. F. J. BANCROFT proposed a hearty vote of thanks to the Chairman and Directors for the excellent way in which they were managing the business through what was a period of extraordinary difficulty for all manufacturers and commercial undertakings generally.

Mr. J. W. BUCKLEY, in seconding, expressed the pleasure with which he noted the very liberal scale on which allowance was made for depreciation under the various heads in the accounts. Both shareholders and consumers would in the future benefit from this policy. Mr. Chapman secured a very high yield of gas per ton of coal; and he was certainly not doing it at the expense of the oil. As a matter of fact, he had made up his mind to see Mr. Chapman, and find out how to get the yield he did from his carburetted water-gas plant.

The vote was passed, and briefly acknowledged by the CHAIRMAN.

The Burnley Town Council have agreed to purchase 23 acres of land at Old Hall Farm, for a gasholder and new works needed to cope with the town's increasing demands.

PUBLIC LIGHTING OF OXTED.

Last Thursday, a Parish Meeting was held at Old Oxted "to consider a proposition that the sum of £90 be raised for the purpose of lighting that part of the parish for which the Lighting and Watching Act has been adopted." The meeting was presided over by Mr. H. W. Matthews, the Chairman of the Oxted Parish Council; but very few of the parishioners attended. It was pointed out that the public gas-lamps in the area affected by the Lighting and Watching Act were in lighting during the six winter months of the year, and that it was necessary, if the arrangement was to be continued during the coming winter, that the resolution should be passed. After a short discussion, this was done.

The district in question is in the area of the Oxted and Limpsfield Gas Company, Limited. Our correspondent calling at the works of the Company found the Manager (Mr. W. Sperring), who gave a few details of the matter, and gas affairs in Oxted generally. He stated that the price of gas was 4s. per 1000 cubic feet; while for the public lighting it was 3s. 6d. The number of public lamps concerned was 37. Mr. Sperring also said the mileage of mains was 14, the output of gas 20 million cubic feet, and the number of consumers 540. Interesting were the statements that it was fourteen years since he came to Oxted; that he had increased the output from 7 to 20 millions; and that he was an old "Phœnix" man from Bankside. Specially reminiscent was Mr. Sperring with regard to the black days of 1889 (the great strike), when he was at Bankside. He recalled to mind Mr. Charles Carpenter (who was then at the Vauxhall station), coming from Greenwich on the Company's tug with a barge laden with provisions, which he left in his charge at Bankside for those who were working. Equally interesting was his description of the South Metropolitan cricket team going to Beckton to play the Gas Light and Coke Company's team, one of the principal members of the visiting, and the winning, team being Mr. Frank Bush, the late Secretary.

AMERICAN STANDARD SPECIFICATIONS.

For Cast-Iron Pipe and Special Castings.

There has been issued by the American Gas Institute a series of standard specifications for cast-iron pipe and special castings. One section (adopted in 1911) gives weights, dimensions, &c., for bell-and-spigot pipe and special castings, and another (adopted in October last) of flanged pipe and special castings. The principal sections of the general specification are given below; the remaining ones deal with the furnishing of men and materials, the power of the engineer to inspect, reporting by the inspector, the delivery of castings, and the definition of the word "engineer."

STANDARD SPECIFICATIONS FOR CAST-IRON PIPE AND SPECIAL CASTINGS.

Description of Pipe and Special Castings.—All pipe shall be made with bell-and-spigot joints. The pipe and special castings shall accurately conform to the dimensions given in the tables of the American Gas Institute standards accompanying, and forming a part of, these specifications. The pipe shall be straight and of true circles in section, with the inner and outer surfaces concentric, and cast at least 12 feet in length, exclusive of socket or bell. In the case of pipe of different weight from those specified in the tables, the outside diameter of the body and bell dimensions shall conform to the tables.

Allowable Variation in Diameter.—All sockets and spigots shall be tested by circular gauges. All pipe and special castings shall be rejected which are defective in joint room, or which vary from standard dimensions in the diameters of the sockets and the outside diameters of spigots more than is given in the table below.

Size.	Pipe.	Special Castings.
16 in. or less	0·06 in.	0·12 in.
20 in. and 24 in..	0·08 ,,	0·15 ,,
30 in., 36 in., and 42 in. . . .	0·10 ,,	0·20 ,,
48 in.	0·12 ,,	0·24 ,,

Allowable Variation in Thickness.—The variations allowed below the standard thickness shall not be greater than that shown in the table below.

Size.	Pipe.	Special Castings.
8 in. or less	0·08 in.	0·10 in.
10 in. to 36 in.	0·08 ,,	0·12 ,,
42 in. and 48 in..	0·10 ,,	0·15 ,,

For all sizes of pipe, and for specials 10 inches or larger, variations from the standard thickness of 0·02 inch in excess of the allowances above given shall be permitted for spaces not exceeding 8 inches in length in any direction.

Treatment of Defective Spigots.—Defective spigot ends on pipe 12 inches or more in diameter may be cut off in a lathe, and a half-round wrought-iron band shrunk into a groove cut in the end of the pipe. Not more than 12 per cent. of the total number of accepted pipes of each size shall be cut and banded; and no pipe shall be banded which is less than 11 feet in length, exclusive of the socket. In case the length of a pipe differs from 12 feet, the standard weight of the pipe given shall be modified in accordance therewith.

Marking.—Every pipe and special casting shall have distinctly cast upon it the initials of the maker's name. When cast especially to order, each pipe larger than 4 inches may also have cast upon it figures showing the year in which it was cast and a number signifying the order, in point of time, in which it was cast; the figures denoting the year being above and the number below thus—

1913.	1913.	1913.
1 ..	2 ..	3

Also any initials, not exceeding four, which may be required by the purchaser. The letters and figures shall be cast on the outside, and

shall not be less than 2 inches in length and ⅛-inch in relief, for pipe 8 inches in diameter and larger. For smaller sizes of pipe, the letters may be 1 inch in length. The weight shall be conspicuously painted in white on the inside of each pipe and special casting.

Allowable Percentage of Variation in Weight.—No pipe shall be accepted the weight of which shall be less than the standard weight by more than 5 per cent. for pipe 16 inches or less in diameter, and 4 per cent. for pipe more than 16 inches in diameter; and no excess above the standard weight of more than the given percentage for the several sizes shall be paid for. The total weight to be paid for shall not exceed for each size and class of pipe received the sum of the standard weights of the same number of pieces of the given size and class by more than 2 per cent. No special casting shall be accepted the weight of which shall be less than the standard weight by more than 10 per cent. for sizes 12 inches or less in diameter, and 8 per cent. for larger sizes, except that curves and Y-pieces 16 inches in diameter and larger may be 12 per cent. below the standard weight; and no excess above the standard weight of more than the above percentages for the several sizes will be paid for.

Quality of Iron.—All pipe and special castings shall be made of cast iron of good quality, and of such character as shall make the metal of the castings strong, tough, and of even grain, and soft enough to satisfactorily admit of drilling and cutting. The metal shall be made without any admixture of cinder iron or other inferior metal, and shall be re-melted in a cupola or air-furnace.

Tests of Material.—Specimen bars of the metal used, each being 26 inches long by 2 inches wide and 1 inch thick, shall be made without charge as often as the engineer may direct; and in default of definite instructions, the foundry shall make and test at least one bar from each heat or run of metal. The bars, when placed flatwise upon supports 24 inches apart and loaded in the centre, shall support a load of 1800 lbs. and show a deflection of not less than 0·30 inch before breaking. Or, if preferred, tensile bars shall be made, which will show a breaking-point of not less than 18,000 lbs. per square inch. The foundry shall have the right to make and break three bars from each heat or run of metal; and the test shall be based on the average results of the three bars. Should the dimensions of the bars differ from those given above, a proper allowance therefor shall be made in the results of the tests.

Tests of Pipe.—All pipe, after having a general inspection, shall be subject to a water-pressure test of at least 300 lbs. per square inch for 16 inches and smaller, and at least 150 lbs. per square inch for 20 inches and larger. If required by the engineer, they shall also be subjected to a hammer-test under this pressure. Any pipe showing defects by leaking, sweating, or otherwise, shall be rejected.

Casting of Pipe. - The pipe shall be cast vertically in dry sand moulds, and shall not be stripped or taken from the pit while showing colour of heat, but shall be left in the flasks for a sufficient length of time to prevent unequal contraction due to subsequent exposure.

Quality of Castings.—The pipe and special castings shall be smooth, free from scales, lumps, blisters, and sand-holes, and defects of every nature which unfit them for the use for which they are intended. No plugging, filling, or burning-in will be allowed without special permission.

Cleaning and Inspection.—All pipe and special castings shall be thoroughly cleaned and subjected to a careful hammer inspection.

Weighing.—The pipe and special castings shall be weighed for payment, under the supervision of the engineer. If desired by the engineer, the pipe and special castings shall be weighed after their delivery, and the weights so ascertained shall be used in the final settlement, provided such weighing is done by a legalized weigh-master. Bids shall be submitted and a final settlement made upon the basis of a ton of 2000 lbs.

SUPPLY OF GAS-MANTLES IN WAR TIME.

Views of the Birmingham Ironmongers' Association—Advance in Price.

At a Meeting of the above-named Association last Tuesday, the Hon. Secretary drew attention to the impending shortage of gas-mantles, and said it was desirable that the Association should seek the co-operation of the Master Gas-Fitters' Association in fixing minimum selling prices. His idea was that they should advance all mantles by 1s. per doz. He understood, however, that they would have to reckon with some competition from the Municipal Gas Department; for this authority had decided to make no advance in the price of their mantle, which would still be retailed at 4d. Mr. J. Thacker said he understood the Gas Department had approached certain factors with a view to fixing a list of minimum prices, based on the several classes of mantle; but the idea proved impracticable, because, as the factors pointed out, only about 10 per cent. of their trade was done in Birmingham, the other 90 per cent. being in the country. It was worth noting that there were only four mantle makers in this country, and between them they only made 25 per cent. of the mantles used here; while even of this small proportion the thorium preparation, and the clay rings in the case of inverted mantles, were all imported from the Continent. It was plain to see, therefore, that there must be a famine in mantles before long. His own view was that the stocks in this country would be exhausted by Christmas. He had been offered more than current retail prices for the whole of his stock by London factors. He had had equally tempting offers for his stocks of glass. Had they offered to buy his whole business on such terms he would have closed with them, and been glad to be rid of it. He understood that the Birmingham Corporation had 23,000 mantles in stock at the end of July, and they were able to place orders for 80,000 more when the crisis occurred. It was resolved to advance the prices of all mantles by 1s. per doz. forthwith.

According to a paragraph under the heading "Trade and the War," in last Saturday's "Ironmonger," "manufacturers of incandescent gas-fittings in Birmingham do not share the view that a shortage of gas-mantles is imminent, and are going ahead making fittings and burners for all they are worth. The demand for burners, owing to the stoppage of German supplies, is extremely heavy, and some of the firms engaged in the trade are working practically night and day. Their optimism regarding the supply of mantles is based on the belief that when a combine among the British and German mantle makers was mooted at the end of last season importers bought heavily, and as a consequence considerable stocks are on hand."

DYESTUFF MANUFACTURE IN AMERICA.

In view of the difficulties arising out of the European war, and the recognition of the fact that the large majority of the dyes at present employed in America are manufactured in Germany, the question of the establishment of the dyestuff industry on the other side of the Atlantic has been under consideration, as large quantities of raw material are available for the purpose. The subject was dealt with by Mr. J. M. Matthews in a recent number of the "Daily Trade Record;" some of his observations being as follows.

As nearly all the dyes are made from coal tar, and as this is derived from the distillation of coal for the production of illuminating gas, it would be the first impression that we could ourselves quickly utilize our coal-tar products. A little careful consideration of this question, however, causes us to revise our first judgment somewhat. Considerable difficulties confront us, though they can all be overcome.

While it is true that America produces large quantities of coal tar, it is also true that Americans are not very large producers of benzol and its congeners, which form the real bases of the dyestuff substances. The character of the coal employed and the method of conducting its distillation cause wide variation in the quantity and nature of the constituents present in tar. The tar obtained by existing American methods of distillation is capable of yielding but a very small quantity of benzol and anthracene – two of the principal raw materials used as a starting-point in the manufacture of coal-tar dyes. We shall have to change our system of producing illuminating gas so as to leave the proper kind of tar. This will eventually permit a greater profit even to the gas maker, besides giving the dyestuff maker the ingredients he needs. While our coal tar does not yield much benzol and anthracene, it does yield a large quantity of naphthalene, which can be employed for the production of indigo and a few other dyestuffs, but it does not find any very extensive use outside of the indigo colours. There are in America several establishments where some coal-tar dyestuffs are produced, but nearly all of them depend on Europe for most of their raw materials and intermediate products; and should these supplies be cut off, they would be in a very poor condition to supply, even to a small extent, the requirements of the textile trade.

The most important dyestuff is indigo, for it is employed in larger quantity than any other. At the present time a very large quantity of our supply of indigo is made in Germany from coal tar; this product having, to a large degree, displaced the natural indigo; formerly obtained by extraction from the indigo plant. The indigo made from coal tar is identical with that from the plant, and is in a much higher state of purity. It is also brought into trade in a form which is more readily adapted to the dyeing process. We have in America large quantities of naphthalene available for the production of indigo; but foreign patents would stand in the way of our making this colour economically. We shall have to revise our patent laws, compelling foreign patentees to produce in America. Further, we must develop our own methods of production. It is no doubt true that the suppression of the synthetic indigo making would stimulate very largely the cultivation of natural indigo, which chiefly comes from India and the East Indian Islands; and it is probable that our supplies of indigo could be largely drawn from this source. During the last few years, however, the acreage of indigo under cultivation has been very widely reduced, owing to the material decrease in price through competition with the synthetic indigo; and it would take some time to readjust agricultural conditions in East Indian countries so as to increase very materially the production of vegetable indigo.

If necessity, growing out of a protracted war in Europe, demanded it, there is no doubt that our methods of distilling coal for the production of illuminating gas could be so modified as to form a coal tar suitable for the production of benzol and other intermediate products in the dyestuff industry.

GERMAN-MADE GOODS FOR ENGLAND

Via Holland and Denmark.

The "Evening News" last week was vigorously protesting against the continued trading with German firms—some with English sounding names—that is being carried out and attempted, notwithstanding the various Orders in Council forbidding any business dealings with enemies of the country. In Wednesday's issue there was quoted in full a letter sent from Barmen, under date of Aug. 26, to the Voelker Lighting Corporation, Limited. It was as follows:

Barmen, Aug. 26, 1914.

Dear Sirs,—Your favour of the 31st of July came to hand only about a week or so ago. Since war broke out the traffic is totally stopped; so there seems to be no chance at present to send any goods direct to England. Our factory is closed; and we fear same will not be opened again for some time to come. We are glad to say we have a big stock in your various qualities.

We suppose you will soon require deliveries in ——; and if this is so, we should thank you for giving us instructions at an early date, so that we can watch the opportunity, when the traffic will be open again. You might please address your reply in an open envelope to Messrs. August Bacher Soehne in Rotterdam, to whom we are indebted for

forwarding this letter to you, and who will, no doubt, be ready to transmit us your reply.

Thanking you in anticipation, &c.,
FROWEIN AND WIESCHER.

The Voelker Company are bringing the matter to the notice of the Board of Trade. According to our contemporary, arrangements are being made for the shipping of large numbers of incandescent mantles, bearing no name, and the boxes without printed matter, and therefore not requiring the words "Made in Germany," through Danish and Dutch houses to this country and the Colonies.

Meanwhile it is certain that the time has come for the Board of Trade to establish a special department for the detection of German attempts to trade with this country *via* Holland, Denmark, and the United States.

A new law is urgently needed for the compulsory registration of all private companies, so that it may be publicly known how far they are German controlled. It is of no use to measure German methods by English standards. In trade they are on a level with those in the field.

METROPOLIS WATER SUPPLY.

The Quality of the Water as Delivered to the Consumers.

In the concluding portion of his last annual report on the results of his chemical and bacteriological examination of the London waters, Dr. A. C. Houston, the Director of Water Examination to the Metropolitan Water Board, makes the following remarks on the quality of the water as finally delivered to the consumers.

Over eight years' work on the London Water Question has convinced me that to a progressively increasing extent the Water Board are securing the reasonable, if not absolute, "safety" of the Metropolitan water supply. This opinion will carry the more weight since I have been, and still remain, a somewhat merciless critic of any imperfections in the processes of water purification.

As a counsel of perfection, I still feel bound to advocate the choice of an initially pure source of water supply; but my own results and experiments do seem to indicate clearly that the evil effects even of an impure source can be largely, if not entirely, annulled by adequate storage and efficient filtration. It needs to be remembered, however, that the more water that is abstracted from a river for water-works purposes, the less easy does it become to select water of good quality.

Hence the importance in the future of carefully considering those supplementary processes of purification alluded to in previous reports, either interposed between the river and the storage reservoirs, or between the storage reservoirs and the filters, or in both of these places. Theoretically, at all events, it ought to be possible to bring to a uniform state of purity all river water antecedent to storage, or (but to a different standard) all stored water antecedent to filtration. Under existing conditions, when the rivers are in flood, either the intakes are closed and the reservoirs depleted, or flood water is taken into store which ought not to have been selected.

It is the more important to consider carefully these matters, because still more critical periods will sometimes occur when the rivers are running too low to allow much, if any, water being abstracted for water-works purposes. During these periods the filters are being fed from storage reservoirs, and are really, as it were, borrowing on capital. The reserves may never be completely exhausted; but when the river water again becomes available for water-works purposes, it is likely to be specially impure in quality, and, besides, it is not possible with depleted reservoirs to purify it rapidly by storage. It follows that, during the storm periods following drought, supplementary processes of water purification ought to be adopted if most impure water is to be rendered reasonably pure.

A system in which a river water of reasonably good and uniform quality is pumped into a nearly full storage reservoir of adequate capacity at the same rate as water is being abstracted for filtration purposes is in a state of what may be termed "quality equilibrium." Any falling-off in the quantity or the quality of the river water upsets this equilibrium in greater or less measure.

Reservoirs and filters possess, it is true, an immense "reserve of purifying ability," but it would be a most unwise policy to take too much advantage of this circumstance, and abstract river water independently of its quality, or rush impure river water through depleted service reservoirs in the hope that the sand filters would sufficiently remove the impurities. Hence arises the desirability of considering the feasibility of adopting a new factor in the London water question—viz., the occasional employment of supplementary processes of purification.

Subject to these qualifications, I consider that the means now adopted, or in process of adoption, for the purification of the Metropolitan water supply are such as to render the water reasonably, if not absolutely, "safe" for drinking purposes.

Burton-on-Trent Gas-Works Loans.—The Local Government Board have notified their sanction to the borrowing by the Burton Corporation for the extension of the new retort-house and other plant, of £6400 and £600 respectively. The period allowed for repayment in respect of the former loan is 28 years; for the latter 10 years. The £600 is in respect of the coal conveyor and coke conveyor, together with a proportion of the item for contingencies. The Board state that they have decided to comply with the application so far as regards the works to be immediately undertaken; and that as regards the remaining sum of £18,000 (the Corporation asked for £25,000 in all), the Board state that this portion of the application must remain in abeyance until it is necessary to proceed with the works. When the application is renewed, they will need to be furnished with revised estimates based upon provisionally accepted tenders, together with plans and a short report explaining the necessity for the works.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Sept.* 7.

The markets for tar products remain in a quiet state. It is reported that a large quantity of ordinary London creosote has been sold at 4 1/16d. net per gallon and equivalent to f.a.s. London. Carbolic acid is not quite so strong as recently; but there is no pressure to sell.

The position of sulphate of ammonia is unchanged at £10 15s. net per ton for 25 per cent. quality, naked at makers' works. There are rumours that the price in the United States has risen materially.

Sulphate of Ammonia Prices in the Provinces.

LIVERPOOL, *Sept.* 5.

Although the further decline in prices has only been small, there has been a drooping tendency in the market throughout the week. Some buying has taken place for the purpose of covering former sales, but fresh orders have not been much in evidence. The nearest values at the close are £10 10s. per ton f.o.b. Hull, £10 11s. 3d. f.o.b. Liverpool, and £10 12s. 6d. f.o.b. Leith. Future delivery is still neglected; the present situation being too unsettled for either buyers or sellers to operate far ahead.

Nitrate of Soda.

The market for this article has given way further, and spot quotations have been reduced to 10s. 9d. per cwt. for ordinary quality, and 11s. for refined.

COAL TRADE REPORT.

Northern Coal Trade.

The demand for coal is rather fuller; but the exports are still impeded by the difficulties as to payment, and some of the freights are also heavy. In steam coal, best Northumberlands are being shipped more freely to some Russian ports, and are quoted at about 13s. 3d. per ton f.o.b. For second-class steams, the quotation is from 11s. to 11s. 4d. per ton. Steam smalls are firm at about 8s. 6d. to 9s. 9d. per ton f.o.b—with a generally good demand. Work at the collieries is still short; but the miners at work are fewer, and thus the output is taken up fairly well. In the gas coal trade, the demand increases, both for home use and for export; but even the enlarged inquiry is barely the autumnal one yet. Best Durham gas coals are 12s. 6d. to 13s. per ton f.o.b.; for second-class kinds the quotation is about 11s. 3d. per ton; while for "Wear specials" nearly 13s. per ton is the f.o.b. price. There is rather more demand for gas coal for Italy, but the rates and freight are high—about 9s. Tyne to Genoa being one of the basis rates at present—while the additional cost of insurance tells. But, as time passes these difficulties are being adjusted, and shipments should increase, especially of gas coal, as the days shorten. The coke market is steady. The price of gas coke shows more variation, and good qualities for export vary from 11s. 6d. to 12s. 3d. per ton f.o.b. Stocks of gas coke are rather heavy, as shipments have been irregular.

Conditions of Labour at Stockport.

At the last meeting of the Stockport Town Council, the Chairman of the Gas Committee (Mr. J. Winter, J.P.) stated that several members of the Municipal Employees Association had interviewed the Mayor (Mr. T. W. Potts, J.P.), some members of the Council, and himself, with reference to the alleged discharging of a number of outside men when the laying of a main in the Heaton Norris district was finished, in accordance with the rules of the department. The Gas Engineer (Mr. S. Meunier) having reported upon the matter, it was resolved that the Town Clerk (Mr. Robert Hyde) should write to the General Secretary of the Municipal Employees' Association requesting him (1) to cause all communications on such matters to be made to the Gas Committee through the General Secretary, and not from men to members of the Council; and (2) to inform him that, with a view to finding work during the present slack period for the greatest number of employees, it is suggested that the men should work alternate weeks only, and to ask for the views of the men on the subject. The Gas Engineer reported that thirteen members of the staff and workmen had been called up for the Army and Navy; and he was deputed to fill the vacancies temporarily.

Gas-Coal Contracts at Rochdale.—At their last meeting, the Rochdale Corporation Gas Committee considered tenders for the supply of coal to the gas-works during the next twelve months, and gave out contracts for 60,000 tons. The average price is about 1s. per ton less than last year, which means a saving of £3000 to the department.

Croston Council Gas-Works.—At the last meeting of the Croston (near Preston) District Council Gas Committee, a letter was read from a ratepayer protesting that it was not fair to private traders that the Council should retail mantles for incandescent burners. It was decided that the Council should discontinue retailing mantles and burners unless their employees were called upon to fix them. It was reported that the gas profits during the past year amounted to £189.

Tonbridge Gas Company.—At the half-yearly meeting, Mr. W. Judd (who presided) said he had never moved the adoption of the report with greater satisfaction than on this occasion. They were again able to pay the full statutory dividends, which had been more than earned. There had been an increased consumption of 6 million cubic feet during the half year; and this was a record in the history of the Company. The result of the working was a profit balance of £2717—about £200 more than it was during the corresponding half of 1913. The dividends amounted to £2084; and there would be an unexpended balance of £6350 to carry forward for any emergency.

Shrewsbury Gas Company.

In moving the adoption of the report [*ante*, p. 414] at the annual meeting of the Company, Mr. T. F. Poole (the Chairman) said the profit on the past year's working was less than that for the preceding year; but there were good reasons for this. Coal had cost much more, in consequence of the rise in price, and of the larger stock they were bound to hold against contingencies. On the other side, they had received more for gas and fittings, but less for residuals. The result was an increase of £1062 in the expenditure, and a decrease of £327 in the receipts, making together a reduction of profit of £1389. This would necessitate the use of £1341 of the floating balance in the profit and loss account to pay the full dividend. The price of gas ought really to have been raised in July, 1913; but it was inadvisable to recommend this as long as they had an available balance in the profit and loss account. Since the last meeting, the Directors had established a co-partnership scheme with their officers and workmen. The object of this was to give them a personal interest in the wellbeing of the business, since they would share in the profits, and were intended ultimately to become shareholders in the Company. The amount of one year's bonus recently declared was £392. The report having been adopted, a dividend making with the interim payment 5¾ per cent. for the year was declared. Acknowledgment was made of the services of the Chairman and Directors and the Secretary and Engineer (Mr. W. Belton) and staff.

The Water-Slide Chandelier.—While in the act of filling up an old-fashioned water-slide chandelier, by the aid of a lighted candle, a Mr. Solomon, of Cardiff, was somewhat burned by a gas explosion. His daughter was also slightly hurt; while a good deal of damage was caused to the room. No doubt he will now be wise enough to discard fittings of this character in favour of others of more modern pattern.

Cork Gas Consumers' Company.—The report for the past half year, which was noticed on p. 529 of last week's issue, was at the meeting referred to as a favourable one by the Chairman (Mr. George Lynch). He said that, compared with a year ago, there had been an increased sale of gas under every head. Coal sufficient to last for all next year had been secured at less then 1913 prices. The Chairman dealt at some length with the "Lancet" gas-stove tests. The report and accounts were subsequently adopted without discussion.

Profit-Sharing at Maldenhead.—Referring to the report, at the half-yearly meeting of the Maidenhead Gas Company, Mr. J. W. Walker, the Chairman, said they were introducing a system of profit-sharing among the employees. This would take the form of a bonus upon wages, the rate depending upon the price of gas—the cheaper the gas, the higher the bonus. By this means, the benefit of a reduction in price, which has hitherto been shared only by consumers and stockholders, would be extended to the employees. The recommendation of a 6 per cent. dividend was adopted.

Reduction in Price at Cambuslang.—The Directors of the Cambuslang Gas Company, Limited, have reduced the price of gas from 2s. 9d. to 2s. 6d. per 1000 cubic feet, subject to 5 per cent. discount if gas is used to a reasonable extent for cooking. The reduction is to take place immediately after the September survey of meters.

High Wycombe Gas Company.—The half-yearly meeting of this Company is being held to-day (Tuesday), when the Directors are reporting that the profit for the past half year amounted to £1175. to which was added £2639 brought forward from the preceding half year, and bank interest—making a total of £3827. After paying interest on the debentures, and providing for the dividends on the preference shares, there remains a balance of £3505, out of which the Directors are recommending payment of dividends at the rates of 10 and 7 per cent. per annum on the original and additional shares respectively, amounting to £917, and leaving a balance of £2588 to be carried forward. Under the control of Mr. Harold Baker, the Secretary and Manager, the report remarks: "The works and plant have been maintained in good order."

Lighting of Ecclefechan.—The residents of Ecclefechan are faced with the question of the future of public lighting in the district. For several years Mr. Brook, of Hoddom Castle, has been mainly responsible for the illumination of the street-lamps; and householders have also been able to avail themselves of light from the same source at a moderate charge. Mr. Brook, however, has intimated that he would like the inhabitants to relieve him of this undertaking; and he has offered to hand over to a representative Committee a thoroughly up-to-date plant, on condition that they will maintain the service themselves. A Committee has been elected to confer with the factor to Mr. Brook; but no decision has so far been arrived at. It is felt that Lockerbie and Annan should first be approached, with a view to ascertaining if it would be feasible to extend gas-mains to Ecclefechan, and also at what price per 1000 cubic feet gas could be supplied. There is an impression that gas would be infinitely better than petrol, if a scheme could be carried out.

Bognor Gas Company.—Presiding at the half-yearly meeting, Mr. H. Lovett, J.P., said coal and oil had cost the Company over £1200 more; while the damp weather had prevented them proceeding with the new retorts as they would otherwise have done. The Directors thought it would be best during the present troublous times not to interfere in any way with the reserves, and he hoped the shareholders would agree that they were doing the right thing in reducing the rate of dividend to 3 per cent. per annum. Bognor was increasing more than any town on the south coast, and they might look forward to a prosperous future. Mr. Denton remarked that it was marvellous a small works like theirs should have been able to stand the issuing of £41,000 of fresh capital. The electric light department was progressing satisfactorily. Mr. T. N. Ritson pointed out that the output had increased by 8 per cent.; and he commended the Directors upon husbanding the reserves. The report was adopted, and subsequently the Board were authorized to issue a further £10,000 of capital.

R. & J. DEMPSTER, Ld., Gas Plant Works, MANCHESTER.

London Office: 165, Gresham House, Old Broad Street, E.C.

The Portsmouth Water-Fittings Company, Limited, has been registered with a capital of £5000, in £1 shares, to carry on the business of suppliers and repairers of water fittings and apparatus, manufacturers of pipes, water-meters, kitchen ranges and boilers, tanks, and cisterns.

The half-yearly meeting of the Gosport Water Company adopted the Directors' report, which showed that the revenue was £6026, of which £3278 had been carried to the profit and loss account, which was then made up to £6007. The Directors recommended the payment of the full statutory dividends of 4½ and 5 per cent. on the preference stock, 6 per cent. per annum on the 10 per cent. ordinary stock, and 4½ per cent. on the 7 per cent. ordinary stock (1883 and 1897); the balance carried forward being £3504.

At the meeting of the Halifax Town Council last Wednesday, Alderman Morley moved that, in view of the crisis arising with regard to unemployment and short time, both for small employers and workers, the Council decide that on and from July 1, 1914, all consumers of gas who pay the rate of 2s. 1d. per 1000 cubic feet, and slot-meter users, shall receive such discounts from their accounts that they shall not pay more than the cost price of gas. The motion, however, was not seconded, and therefore it fell to the ground.

The Manager of the Herne Bay Gas and Electricity Company Limited (Mr. C. V. Bennett) has made use of the recent success of our Fleet in the Bight of Heligoland to stimulate, by a prominent advertisement in a local paper, the inhabitants of the town to prompt action in laying in a stock of fuel for domestic use. He points out that hesitation would have been fatal in the action referred to; and he suggests that advantage should be taken of the low prices of coke—the cheapest, best, most cleanly, and greatest heat-giving of all solid fuels.

APPLICATIONS FOR LETTERS PATENT.

18,996.—Dempster, R., and Sons, Ltd., and Rowlands, J. C., "Telphers." Aug. 24.

19,028.—Davidson, W. B., and Liversedge, A. J., "Washing gases." Aug. 25.

19,073.—Wallwin, J. M., and Sinnatt, F. S., "Burners." Aug. 26.

19,167.—Johnson, J. Y., "Mechanical stokers for furnaces and retorts." A communication from the American Engineering Company. Aug. 27.

GAS COMPANIES IN THE STOCK EXCHANGE.

The Stock Exchange remains closed, and is likely to remain so for some time longer, so far as present indications go. But if any impatience at this be entertained, it must be repressed. The Committee are working hard to arrive at a solution of the situation, but it is one of extreme difficulty. It may be noted, incidentally, that they have been favoured with some half-a-hundred of schemes—all, of course, admirable in themselves, but differing from each other according as the special views (or, in other words, the special interests) of each writer may dictate. An important step towards clearing the atmosphere and enabling the Committee to get a better view of the position was taken last week, when they issued a notice to members requiring from them a statement of their commitments now open in securities officially settled and also particulars of their liabilities in respect of loans on capital account. This will, no doubt, be effectual in removing some obstacles which impede the reopening. Meanwhile, an amount of unofficial (and perhaps in a degree undesirable) business is going on. It is a necessity, but nevertheless it is clearly open to abuse. The price of Consols may be quoted about 67 to 68 *ex div.*; but no good purpose would be served by publishing prices of other securities, some of which have been let go at a sacrifice by *bonâ fide* holders under compulsion to realize. The Bank of England rate remains at 5 per cent.; but the amount of money in the market lying idle was such that on Friday the banks and discount houses reduced the rates they allowed on deposits by ½ per cent. Our last Official Quotations List is reprinted below.

OFFICIAL QUOTATIONS AT THE CLOSE OF THE STOCK EXCHANGE ON JULY 30.

Bank Rate (fixed Aug. 8), 5 per cent. Last year, 4½ per cent. Consols, —. Previous week, —.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	April 8	2½	Alliance & Dublin Ord.	59–64	..	3 18 2
374,000	,,	July 10	4	Do. 4 p.c. Deb.	76–79	..	5 1 3
280,000	5	April 29	7½	Bombay, Ltd.	5½–6¾	..	5 17 8
50,000	10	Feb. 26	16	Bourne-mouth Gas and Water } 10 p.c.	29 30	..	5 6 8
373,480	10	,,	7	B 7 p.c.	15 –15½	..	4 10 4
95,000	10	,,	6	Pref. 6 p.c.	13½–14	..	4 5 9
380,000	Stk.	Feb. 26	14	Brentford Consolidated	261–266	..	5 5 3
330,000	,,	,,	11	Do. New	204–209	..	5 5 3
50,000	,,	,,	5	Do. 5 p.c. Pref.	109–111	..	4 10 1
206,250	,,	June 11	4	Do. 4 p.c. Deb.	91–93	..	4 6 0
217,380	Stk.	Feb. 26	11	Brighton & Hove Orig.	208–213	..	5 3 4
244,200	,,	,,	8	Do. A Ord. Stk.	154–159	..	5 0 8
530,000	20	Mar. 26	12½	British	41–45	..	5 11 1
120,000	Stk.	June 26	4	Do. 4 p.c. Deb. Stk.	88–90	..	4 8 11
245,771	Stk.	June 26	4	Buenos Ayres 4 p.c. Deb.	85–87	..	4 12 0
100,000	10	—	—	Cape Town & Dis., Ltd.	1½–2½	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4–6	..	—
100,000	Stk.	June 26	4½	Do. 4½ p.c. Deb. Stk.	70–75	..	6 0 0
157,150	Stk.	Feb. 26	5	Chester 5 p.c. Ord.	108–110	..	4 10 11
1,513,280	Stk.	Feb. 12	5/9/4	Commercial 4 p.c. Stk.	106–108	..	5 1 2
560,000	,,	,,	5½	Do. 3½ p.c. do.	103–105	..	5 1 6
475,000	,,	June 11	8	Do. 3 p.c. Deb. Stk.	69½–71½	..	4 3 11
800 000	Stk.	,,	4	Continental Union, Ltd.	76–79	..	5 1 3
203 000	,,	,,	7	Do. 7 p.c. Pref.	115–118	..	5 18 8
492,270	Stk	—	6	Derby Con. Stk.	123–125	..	4 16 0
55,000	,,	—	4	Do. Deb. Stk.	102–104	..	3 16 11
1,002,180	10	July 29	10	European, Ltd.	17½–18*	..	5 11 1
16,364,910	Stk.	Feb. 12	4/17/4	Gas } 4 p.c. Ord.	98–102	..	4 15 6
2,600,000	,,	,,	3½	Light } 3½ p.c. max.	76–79	..	4 8 7
4,062,235	,,	,,	4	and } 4 p.c. Con. Pref.	96–99	..	4 0 10
4,674,850	,,	June 11	3	Coke } 3 p.c. Con. Deb.	72½–74½	..	4 0 6
258,740	Stk.	Mar. 12	5	Hastings & St. L. 3½ p.c.	87–89	..	5 12 4
70,000	10	April 29	11	Hongkong & China, Ltd.	16¼–16½	..	6 11 4
131,000	Stk.	Mar. 12	⅞†	Ilford A and C	151–154	..	5 2 4
65,780	,,	,,	6⅞†	Do. B	115–118	..	5 8 0
65,500	,,	June 26	4	Do. 4 p.c. Deb.	92–94	..	4 5 1
4,940,000	Stk.	May 14	9	Imperial Continental	150–160	..	5 12 6
1,235,000	Stk.	Feb. 12	8½	Do. 3½ p.c. Deb. Red.	84–86	..	4 1 5
200,242	Stk.	Mar. 12	6½	Lea Bridge Ord. 5 p.c.	119–121	..	5 7 5
561,000	Stk.	Feb. 26	10	Liverpool United A	211–213	..	4 13 11
718,100	,,	,,	7	Do. B	146–148	..	4 14 7
306,083	,,	June 26	4	Do. Deb. Stk.	97–99	..	4 0 10

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
75,000	5	June 11	0	Malta & Mediterranean	4½–4⅝	..	6 9 9
250,000	100	April 1	4½	Met. of Melbourne } 4½ p.c. Deb.	99–101	..	4 9 1
541,920	20	May 28	4	Monte Video, Ltd.	11½–12	..	6 13 4
1,775,892	Stk.	July 29	4½	Newc'tle&G'tesh'd Con.	99⅛–99½	..	4 10 6
529,705	Stk.	June 26	3½	Do. 3½ p.c. Deb.	82–83	..	4 4 10
55,940	10	Feb. 26	7,14,0	North Middlesex 7 p.c.	14–15	..	5 2 8
300,000	Stk.	May 14	8	Oriental, Ltd.	117–122	..	6 11 2
60,000	5	Mar. 26	10	Ottoman, Ltd.	7½–7¾	..	6 9 0
60,000	50	Feb. 26	13	Portsea, Island B	128–131	..	4 19 3
100,000	50	,,	12	Do. C	118–121	..	4 19 2
249,980	5	April 29	8	Primitiva Ord.	5½–6	..	6 13 4
499,960	5	June 26	5	,, 5 p.c. Pref.	4⅜–5	..	5 0 0
521,600	100	June 2	4	,, 4 p.c. Deb.	91–93	..	4 6 0
346,198	Stk.	June 26	4	River Plate 4 p.c. Deb.	85–87	..	4 12 0
150,000	10	May 14	6	San Paulo { 6 p.c. Pref.	10½–11	..	5 9 1
125,000	50	July 1	5	{ 5 p.c. Deb.	47–49	..	5 2 0
135,000	Stk.	Mar. 12	10	Sheffield A	223–224	..	4 9 3
209,984	,,	,,	10	Do. B	222–224	..	4 9 3
523,500	,,	,,	10	Do. C	220–222	..	4 10 1
90,000	10	May 28	9	South African	10½–11½	..	7 16 6
6,429,895	Stk.	Feb. 12	5/9/4	South Met., 4 p.c. Ord.	111–113	..	4 16 8
1,895,445	,,	July 10	3	Do. 3 p.c. Deb.	72½–74½	..	4 0 6
209,820	Stk.	Feb. 26	8½	South Shields Con. Stk.	157–159	..	5 6 11
952,795	Stk.	Feb. 26	6	S'th Suburb'n Ord. 5 p.c.	114–116	..	5 3 5
60,000	,,	,,	5	Do. 5 p.c. Pref.	110–112	..	4 9 3
137,058	,,	June 26	5	Do. 5 p.c. Deb. Stk.	116–118	..	4 4 9
629,740	Stk.	May 14	5	Southampton Ord.	99–102	..	4 18 0
120,000	Stk.	Feb 12	7½†	Tottenham { A 5 p.c.	135–138	..	5 2 8
742,275	,,	,,	6†	District { B 3½ p.c.	115–117	..	5 2 7
181,255	,,	June 26	4	{ 4 p.c. Deb.	87–89	..	4 9 11
182,380	10	Dec. 30	5	Tuscan, Ltd.	5–6	..	8 6 8
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	93–95	..	5 5 3
236,476	Stk.	Mar. 12	5	Tynemouth, 5 p.c. max.	103½–109½	..	4 11 4
				Wandsworth, Wimbledon, and Epsom—			
30,000	Stk.	Feb. 26	8⅝	Wandsworth A 5 p.c.	151–156	..	5 7 4
255,636	,,	,,	6⅝	,, B 3½ p.c.	129–134	..	5 2 7
108,075	,,	,,	5/17/3	,, C 3½ p.c.	110–115	..	5 2 0
352,000	,,	,,	6½	Wimbledon 5 p.c.	117–122	..	5 0 5
98,000	,,	,,	6⅝	Epsom 5 p.c.	121–126	..	5 5 2
88,416	,,	June 26	3	3 p.c. Deb. Stk.	66–69	..	4 6 11

Prices marked * are "Ex Div." † Next Dividend will be at this rate.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

General Manager. No. 5928.

Manager and Collector. Penecuik and District Gas Company. Applications by Sept. 12.

Assistant Engineer and Manager (Colonial). No. 5927.

Assistant Engineer. Rugby Gas Company. Applications by Sept. 15.

Mains Superintendent (Calcutta). Oriental Gas Company. Applications by Sept. 21.

Meter Foreman (Calcutta). Oriental Gas Company. Applications by Sept. 21.

Maintenance Improvers. Worthing Gas Company.

Gas-Works Wanted.

"D.G.," c/o Scripps's Advertising Offices, South Molton Street, W.

Plant, &c. (Second-Hand), for Sale.

Exhauster. Newcastle Gas Company.

Gas Compressors. Broadstairs Gas Company.

Meeting.

British Gaslight Company. 11, George Yard, Lombard Street, E.C. Sept. 23. Twelve o'clock.

Sale of Shares.

Littlehampton Gas Company. By Auction, 25, High Street, Littlehampton. Sept. 23.

Financial Interest.

Meter. No. 5929.